

Training Manual

SpectraPoint™ SP2200 System
Base Station Installation and Maintenance

Issue 1

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Part No. 3215397 I&M



SpectraPoint™ LMDS

Local Multipoint Distribution Services

Preface

To the student

This manual is written as a basic text for understanding the SP2200 system. It is intended for individuals who will install, operate, and maintain the SpectraPoint™ SP2200 Base Station.

Conventions

The following textual conventions are used in this manual:

Note: This is used for clarification of any topic being covered. Note is bolded, followed by a colon, and the note text is *italicized*.

Attention: This is used when something that affects proper operation needs to be stressed. Attention is bolded, followed by a colon, and the attention text is *italicized*.

Warning: This is used when some equipment or procedure can cause bodily harm or death if used or applied incorrectly. Warning is bolded, followed by a colon, and the warning text is *italicized*.

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5	Base Station Cabling
6	Base Station Maintenance
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Class Introduction

Overview

This course is designed to give the student an introduction to the installation and maintenance for the SpectraPoint SP2200 Base Station.

Course Objectives

Given the necessary documentation, equipment, and hands-on time, upon completion of this course, the student will understand the procedures needed and be able to install and maintain the following:

- SP2200 Base
 - Base Channel Group (BCG) and cards
 - Channel Group Combiner
 - Power Distribution Panel
- SP2200 Node
 - SRIU and cards
 - Transmitters and Receivers

Slide 1-1

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SP2200 Base Station Installation and Maintenance (I&M) Class Introduction

This training manual provides information for installation and maintenance (I&M) of the **SpectraPoint™** SP2200 Base Station. See slide 1-1 for course objectives.



Course Information

- Class Introductions
- Daily Schedule
- Logistics
- Course Topics

Slide 1-2

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Course Information

See slide 1-3 for details.



Course Topics

- Base Station Installation Overview
- Base Channel Group Installation
- Node Installation
- Base Station Cabling
- Base Station Maintenance
- Customer Service Support

Slide 1-3

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Course Topics

The course topics are shown in slide 1-3. The student handout is organized in sections to cover each of these topics.



Base Station Installation Overview




Slide 2-1

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Base Station Installation Overview

This section describes the installation of the SpectraPoint™ SP2200 Base Station by subsystem.

This information is intended to assist technicians and installers, as well as those involved in bringing communication infrastructure to communities where none exists.

 **Four Phases of Installation**

- Pre-Installation
- BCG Installation
- Node Installation
- Site Installation Wiring

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Base Installation Overview

Installation of the Base subsystems is performed in four phases as shown on slide 2-2:

- **Pre-Installation** includes site preparation and other tasks performed before actual installation of the SP2200 system can begin. The balance of this section covers the tasks involved.
- **Base Channel Group (BCG) Installation** includes installing all of the BCGs to be deployed. This procedure is outlined in Section 3.
- **Node Installation** includes installation of all the Transmitters, Receivers, and SRIUs for the site. This procedure is outlined in Section 4.
- **Site Installation Cabling** includes building cables, connecting the external communication lines to the Base, connecting the Base to the Node replace the SRIU, and connecting the Transmitters and Receivers. These procedures are outlined in Section 5.

Pre-Installation: Site Preparation

Site preparation is the first step in the Base Station installation process. Before installation can begin at each site, the SpectraPoint™ Deployment Team will have completed the following pre-installation tasks. These are normally part of the Network Plan developed for each customer.

- Design a Cell Plan for the site city or area
- Survey the Base and Node sites, including:
 - Street addresses and map depicting the Base and Node locations
 - Written evidence of permission to use the site, including copies of lease(s)
 - Instructions for obtaining access to the site
 - Delivery instructions for shipping equipment to the site
 - Site Plan, indicating the rack locations.
- Perform a Line of Sight (LoS) survey for all CPEs served within LoS of the Node site
- Perform a Frequency Search & Interference Survey
 - Identify internal frequencies for reuse of broadcast bandwidth
 - Identify existing frequencies and transmission characteristics
 - Identify relevant high-frequency and/or high-power devices (especially at L-band frequencies), to avoid conflicts.
- Survey power availability and deployment requirements
 - Will AC or DC power be used for BCG?
 - SRIU must have a -48 V DC source
 - Is a secondary roof power supply necessary?
- Design the Base Station equipment configuration for the site
 - Number of sectors
 - Number of channels per sector
 - Number of racks
 - Number of Transmitters and Receivers
 - Drawings with locations of power supplies and connections to sources in relations to the Base equipment.

Pre-Installation: Site Preparation, continued

Installation Worksheet

Before beginning the Base installation, the Deployment Team will conduct a Site (physical) survey for each Node using a "Base/Node Installation Worksheet". A sample of the worksheet is provided in the SpectraPoint™ 2000 Series Site Preparation Guide; a copy of the worksheet is also provided in Appendix A at the end of this module. This worksheet is used as the basis for physical information for the deployment, for example:

- Node radio mount locations
- Physical load limits of the structure
- Required setbacks from roof edges
- Special mountings required
- Available clearances needed for antenna field of view
 - no obstructions within +/-70° azimuth for 10 meters from antenna center line
 - no obstructions within -45° elevation for 6 meters from antenna center line

Required Construction

- Complete any required pre-installation construction
 - Structural buildout, such as raceways, walls, bulkheads
 - Electrical/mechanical installation (power, heating, and cooling)

Note: *This phase is always completed by an outside source.*

Other Pre-Installation Tasks

Installation Order Completed

- Draft an Installation Order with site-specific instructions

Site-specific Database Built

- Develop a database of site-specific parameters to be entered into the operating software
- All work is completed at the factory

Delivery of the Equipment

- Arrange for delivery of the Base and Node equipment to the site, as required

Base/Node Installation Worksheet

CUSTOMER

NODE #

DATE _____ REQUESTED SERVICE DATE _____

CONTACT _____

PHONE # _____ OTHER # _____

ADDRESS _____

CITY _____

GPS LOCATION LAT _____ LONG _____

BUILDING MANAGER/CONTACT _____

BUSINESS HOURS _____ AFTER HOURS CONTACT _____

PHONE # _____ OTHER # _____

SECURITY CONTACT _____ PHONE # _____

TYPE OF SERVICE _____

BASE EQUIPMENT LOCATION _____

Distance: BASE EQUIPMENT TO POWER CONNECTION _____

Distance: BASE EQUIPMENT TO NETWORK CONNECTION _____

HARDWARE NEEDED _____

NETWORK EQUIPMENT LOCATION _____

NETWORK PROVIDER _____

NETWORK CONTACT _____ PHONE # _____

AFTER HRS. NTKWK CONTACT _____ PHONE # _____

NODE EQUIPMENT LOCATION _____

ROOF ACCESS _____

SECTOR MOUNTING EQUIPMENT _____

DISTANCE BASE EQUIPMENT TO JUNCTION BOX

NORTH _____ EAST _____ SOUTH _____ WEST _____

SECTOR LOCATION

#TX

POL

BORE

SIGHT
NORTH _____

EAST _____

SOUTH _____

WEST _____

CABLE ROUTING INSTRUCTIONS _____

CABLE PENETRATION _____

LIGHTNING PANEL LOCATION _____

GROUND CONNECTION _____

HARDWARE NEEDED _____

UPS AVAILABLE _____ TYPE _____ DURATION _____

BACKUP GENERATOR REQ'D _____ TYPE (NG, LPG, DIESEL) _____

DURATION _____ LOCATION _____

ADDITIONAL _____

BASE PRIMARY POWER TYPE AND CAPACITY _____

BASE POWER AND BACKUP RACK LOCATION _____

NODE # _____

NODE PRIMARY POWER: TYPE AND CAPACITY _____

NODE POWER AND BACKUP RACK LOCATION _____

ADDITIONAL AIR-CONDITIONING _____

COMMENTS _____

ADDITIONAL CONTACTS:

ELECTRICIAN _____

ROOFER _____

LIGHTNING _____

TOWER CLIMBER _____

MAINTENANCE _____

OTHER _____

PREPARED BY _____ DATE _____



Base Installation

Upon completion of this section, the student will be able to discuss the installation of a SP2200 Base:

- Installation requirements
- Installing a Channel Group Combiner
- Installing a Power Distribution Panel
- Installing a BCG
 - Installing DCDM cards
 - Connecting -48 V DC power
- Powering-up a Base

Slide 3-1

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Base Installation

This section describes the physical installation of the SpectraPoint™ SP2200 Base equipment. See slide 3-1 for section objectives.

Note: *Exact steps are detailed in the SP2200 Base Channel Group Equipment Manual. The procedures shown are based on the equipment manual.*

Attention: *Before proceeding with the installation, please review all safety, electrical and code compliance notices in the SP2200 Base Channel Group Equipment Manual.*

This information in this section is intended to assist technicians and installers, and assumes the following:

- The student has the skills and training required to assemble and test mechanical, electrical, telecommunications and radio equipment.
- The student has access to the tools and specialized equipment required to install, test and adjust these systems.
- Radio transmission equipment installers, electricians and other contractors hold any licenses required at the installed.

Before You Begin

Site Plan Checklist

Check the location against the Installation Plan and any as-built drawings:

- ☐ Electrical facilities, including locations of power drops
- ☐ Building communication bulkheads, walls, rack spacing, cable trays and accessways

Equipment Delivery Checklist

Unpack and check site-specific Base equipment delivered against the Installation Plan:

- ☐ Base Channel Group chassis
 - Pre-installed equipment
 - Channel Cards - CCCP, FRO, HSM, One (1) DCDM
 - DC Supply cards (-48 V DC)
 - DC input card, PMD card
 - Additional DCDM cards (not pre-installed)
 - Associated equipment: PDP (optional) and CGC
- ☐ All required installation tools, job aids, and test equipment
- ☐ Additional Base cables for external connections to the Node and Central Office (CO) bulkheads.

Installation Steps

- | | |
|------------------------------|------------------|
| • Installation requirements | pages 3-3 & 3-4 |
| • Installing a CGC | page 3-5 |
| • Installing a PDP | pages 3-6 & 3-7 |
| • Installing a BCG | page 3-8 |
| • Connecting -48 V DC power | pages 3-9 & 3-10 |
| • Installing a DCDM card | page 3-11 & 3-12 |
| • Powering-up a Base Station | page 3-13 |



Installation Requirements

- Standard 48 cm/19 in rack
- Minimum 30 cm/12 in clearance
- -48 V DC power source needed
- Standard technician's tool kit
- Provisioning the Base

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Installation Requirements

Size and Clearance

The SpectraPoint™ Model 2200 BCG chassis mounts in a standard EIA 48 cm/19 in equipment rack.

- The BCG chassis requires an 8U (36cm/14 in) space.
- Allow at least 30 cm/12 in clearance in the front for inserting BCG cards, and the same amount in the rear for making cable connections.
- Equipment racks are installed as per the site installation plan, in adherence to industry standards, and according to manufacturer's recommended methods of assembly.

Attention: *Base Racks and subrack assemblies are bulky and are often installed in areas with limited space. These may require two technicians to unpack and handle.*

Installation Requirements (continued)

Power

A -48 V DC power source is needed for the installation of each Base Channel Group. An optional Power Distribution Panel (PDP) may be employed for this purpose.

Warning: *Handle -48 V DC cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.*

Tools

Installation requires a standard electronic technician's tool kit, terminal lugs, Heliac cable, N-type connectors, and crimpers. A grounding strap must be provided and worn during installation or removal of any BCG component.

Provisioning the Base

Once the Base and Node hardware are installed per the site installation plan, initial provisioning of the system is accomplished using the Craft Interface Device running SpectraPRO. This information is covered in a separate training course.

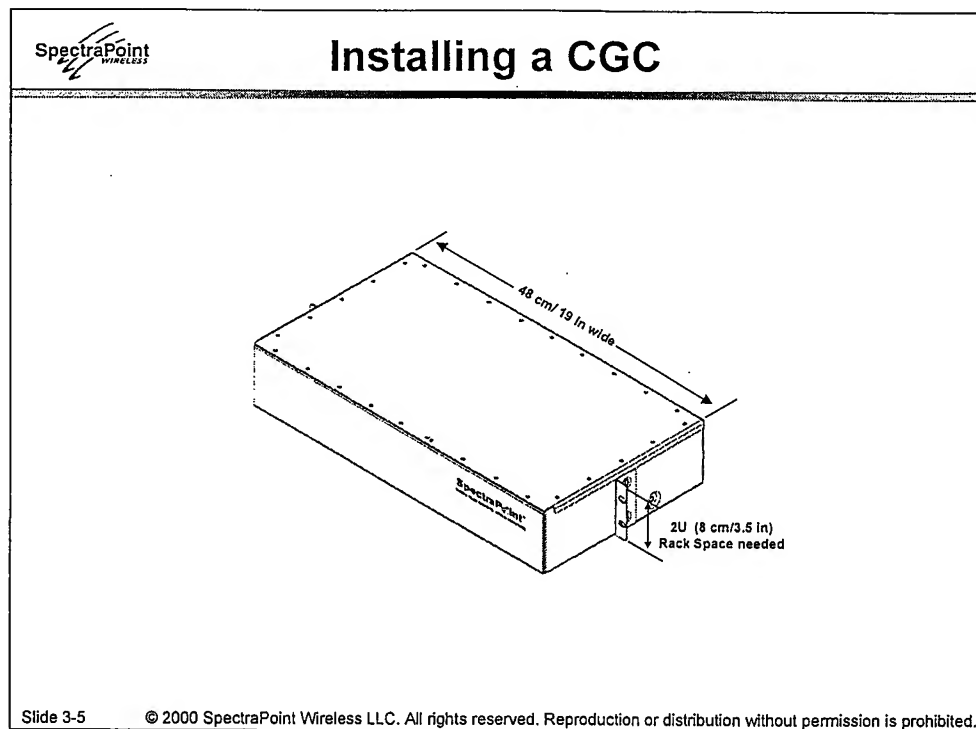
Note - This training manual does not cover the following items:

Gaining permission to perform work

Performing work at a Base Station site typically requires securing permission from the building (facilities) management. This process is not reflected in the steps shown.

Securing needed parts

To perform the steps shown in this section require that the parts needed for the installation must be secured before beginning any work. This process is not reflected in the steps shown.



Installing a Channel Group Combiner (CGC)

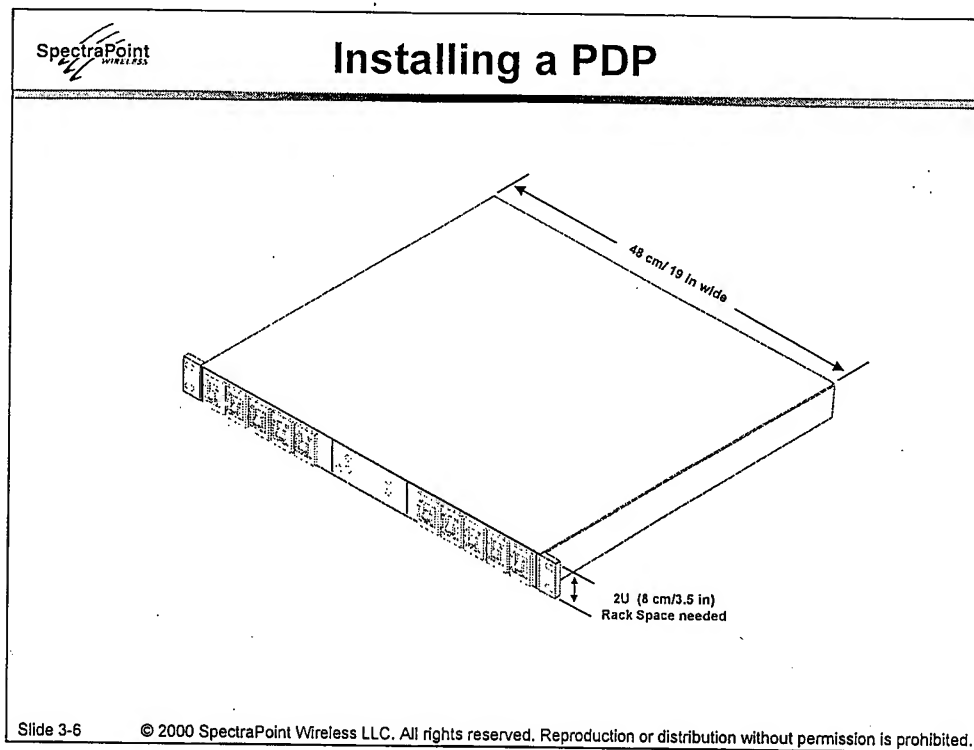
Slide 3-5 shows the Channel Group Combiner (CGC). One CGC is required per Sector; the CGC combines inputs from all the BCGs in one Sector into one coaxial cable to the SRIU for Transmit and one cable for Receive from the SRIU. It may be located remotely (for example, wall-mounted in the same room) based on site-specific needs.

Steps

1. Move the CGC (boxed) near its intended location.
2. Remove the CGC from its shipping container and shipping bag.
3. Move, position, and align the CGC according to the Site Plan.
 - For rack mounting, the CGC requires 2U (8 cm/3.5 in) of vertical space in the rack. Securely mount the CGC at the desired location in the rack using standard rack fasteners.
 - For remote mounting, secure at the selected location using wall anchors, brackets and screws, or a shelf as appropriate.
4. Follow company procedure for disposition of the shipping material.

Note: For more information, please refer to the SP2200 equipment manuals.

This completes the procedure for installing a CGC.



Installing a Power Distribution Panel (PDP)

A drawing of an optional Power Distribution Panel (PDP) is shown in slide 3-6. **Note:** *The PDP shown is generic and for illustration only; using this unit is optional and will site-specific for each deployment.*

General

- One PDP is used per rack, and typically requires 2U (8 cm/3.5 in) vertical mounting space in a 48 cm/19 in rack, and may be located at the top of the rack or may be located separately based on site-specific needs.
- Power is supplied to the -48 V DC Power Supply cards in each BCG from the PDP. Since there is not an ON-OFF switch on the BCG, the PDP serves this purpose.
- The switches in the PDP also serve as circuit breakers, preventing serious electrical damage to the BCGs.
- Depending on the PDP model used, input to the PDP may be 110 V AC, 220 V AC, or -48 V DC. Output is -48 V DC which connects to each BCG on terminal lugs on the DC Input panel in the rear of each BCG.

Installing a PDP

Common Steps

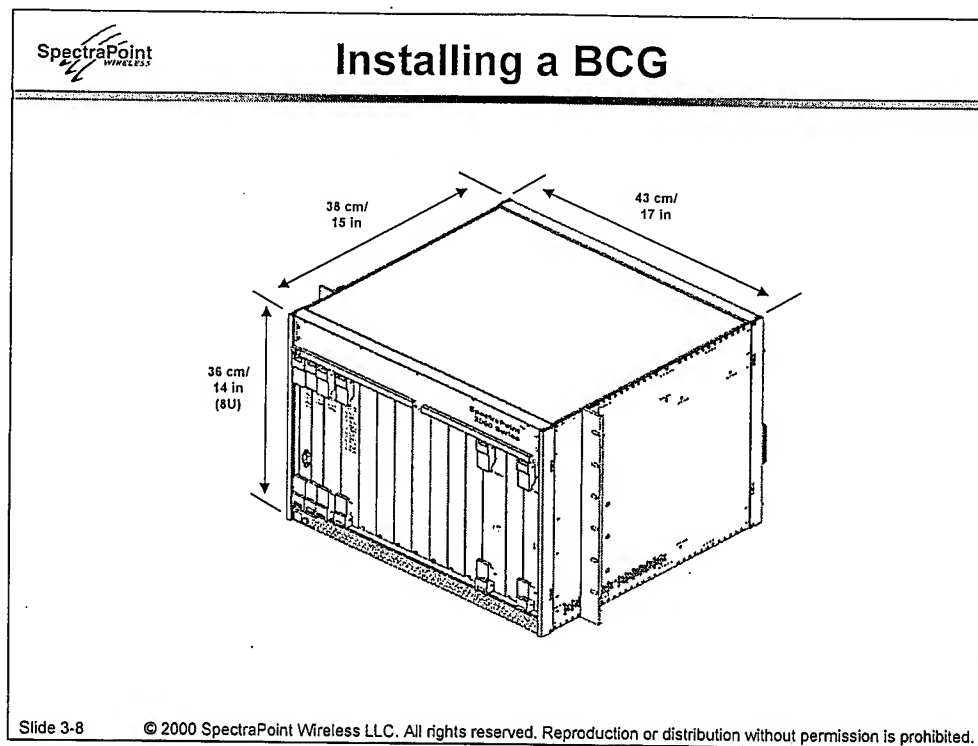
1. Move the PDP (boxed) near its intended location.
2. Remove the PDP from its shipping container and shipping bag.
3. Move, position, and align the PDP in the rack according to the Site Plan.
4. Securely mount the PDP in a 2U (8 cm/3.5 in) space at the top of the 48 cm/19 in rack using standard rack fasteners.
5. Attach the 110 V AC, 220 V AC, or -48 V DC power source to the PDP.

Warning: *Handle all electrical cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.*

6. Follow company procedure for disposition of the shipping materials.

Note: *For exact steps please refer to the manufacturer's instructions shipped with the unit.*

This completes the procedure for installing a PDP.



Installing a BCG

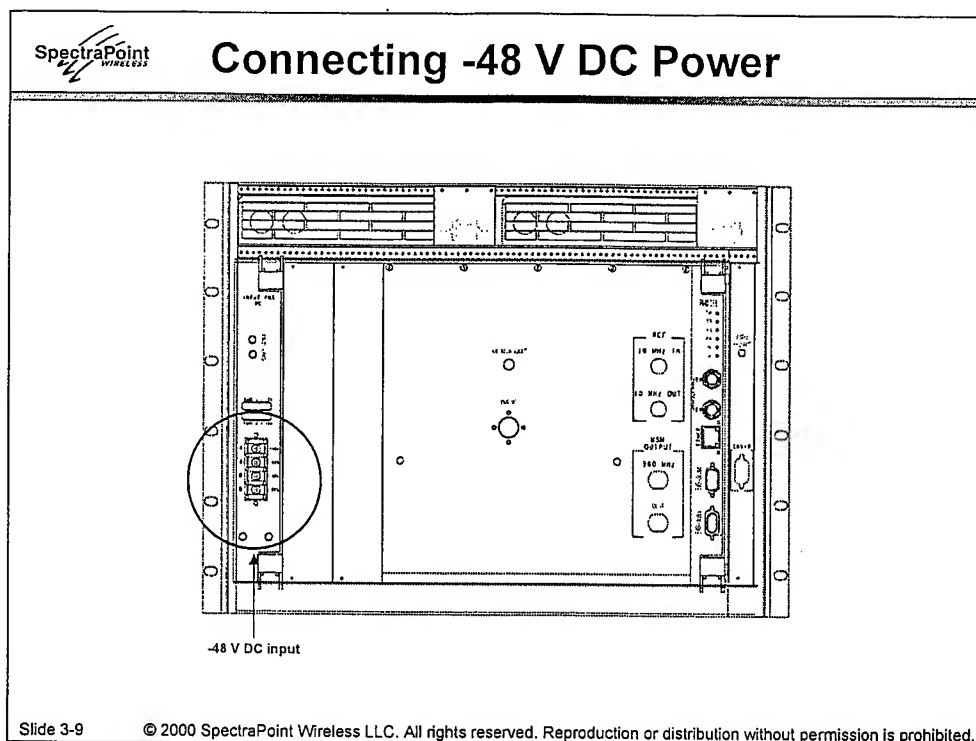
A Base Channel Group (BCG) cabinet is shown in slide 3-8. The BCG is shipped with the following cards pre-installed: CCCP, FRO, HSM, one (1) DCDM, and two (2) DC Supply cards. The DC Input panel and PMD card are also pre-installed (at the rear of the BCG).

Steps

1. Move the BCG (boxed) near its intended location.
2. Remove the BCG from its shipping container and shipping bag.
3. Move and position the BCG according to the Site Installation plan.
4. Securely mount the BCG chassis in an 8U (36 cm/14 in) space in the 48 cm/19 in rack using standard rack fasteners.
5. Follow company procedure for disposition of the shipping material.

Note: For more information, please refer to the SP2200 equipment manuals.

This completes the procedure for installing a BCG.



Connecting -48 V DC Power

Note: All BCG shelves use -48 V DC power only. The -48 V DC power source for the BCG connects to the terminal lugs on the DC input panel as shown in slide 3-9.

Warning: Handle -48 V DC cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.

Steps

1. Measure and cut two lengths of wire (one black, one white) for the -48V DC power feed to the BCG from the power source (normally a PDP).
2. Remove approximately 6 cm/¼ in of insulation from both ends of the -48 V DC power wires.
3. Connect one end to the optional PDP or other -48 V DC power source.

Warning: Be sure that the -48 V DC source is **OFF** before connecting the cables. Be sure to follow color codes used. Failure to follow the color codes may cause fire, explosion, or electrical shock.

Connecting -48 V DC Power

Steps, continued

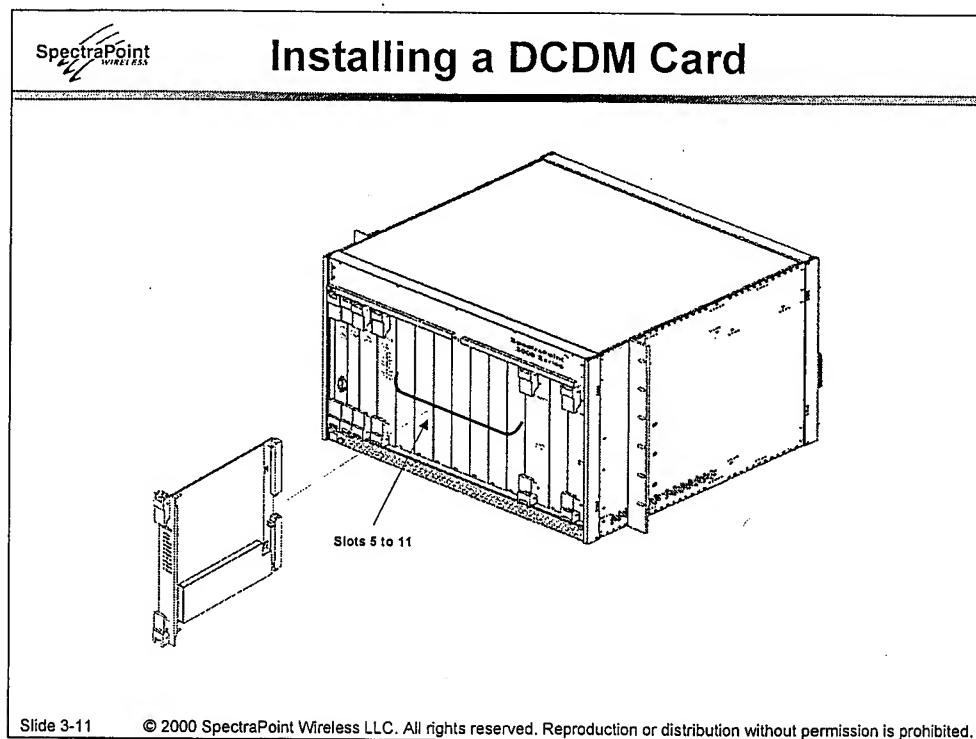
4. Turn on the -48 V DC power circuit serving the BCG.
5. Using a multimeter, check the polarity of the two -48 V DC power wires.
6. Turn off the -48 V DC power circuit serving the BCG.
7. Attach the -48 V DC wires to the appropriate terminal strip screw connectors at the left side of the rear of the BCG, as shown in the slide.

Warning: *Handle -48 V DC cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.*

8. Repeat this process for each BCG.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for connecting -48 V DC power to a BCG.



Installing a DCDM Card

A Base Channel Group (BCG) chassis is shown in slide 3-11. Each BCG is shipped from the factory with one (1) Quad Downconverter/ Demodulator (DCDM) card in slot 4. DCDM cards may be used in slots 4 to 11; additional DCDM cards used in the deployment will be installed in slots 5 to 11.

Steps

1. Move the amount of DCDM cards (boxed) needed near their intended location.
2. Attach an ESD strap to your wrist and to an ESD bond point on the equipment rack.

Attention: Static electricity can damage electronic equipment. Always wear an ESD strap when removing or installing any BCG card.

3. If the BCG was shipped from the factory with blank plates over the slots 5 to 11, identify which slots will be used and remove the blank plates. (optional)
4. Remove a new DCDM card from its anti-static bag and slide it into the card slot in the BCG, as shown in slide 3-11.

Installing a DCDM Card

Steps, continued

Attention: *Handle the DCDM card by the faceplate or by the edges of the card only. Do not touch connectors or components mounted on the face or back of the card.*

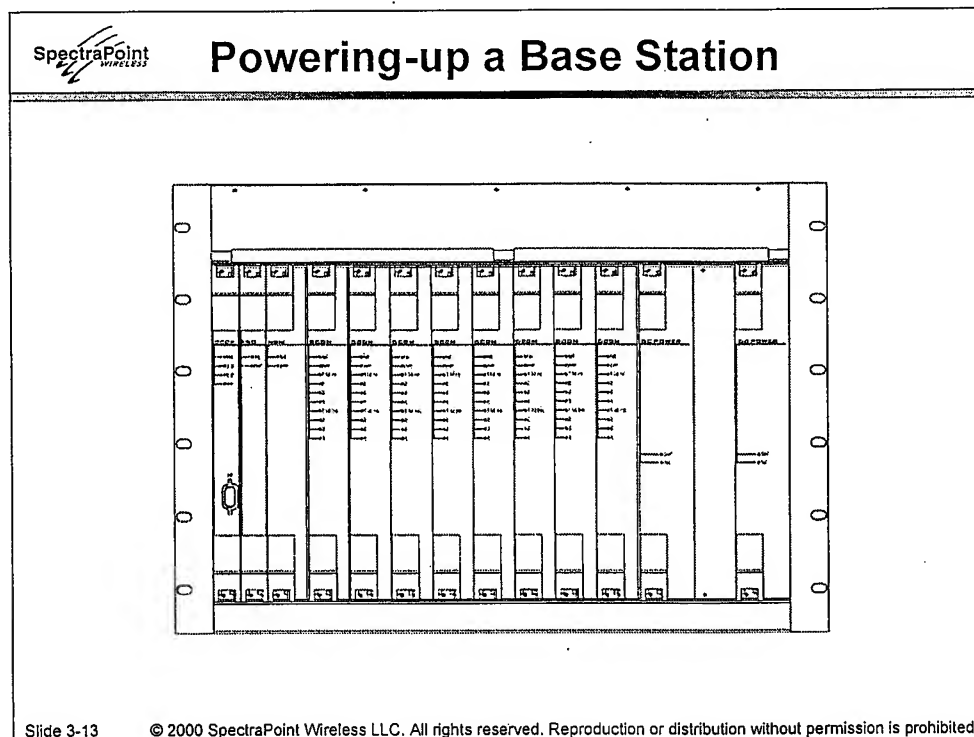
5. Slide the card into any available DCDM card slot in the BCG chassis. When the card reaches the back of the slot, seat the card in the backplane socket, and flip the card latches in place.

6. Repeat steps #2 and 3 for all DCDM cards to be installed in the BCG per the installation order.

7. Remove the ESD strap.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for installing a DCDM card.



Powering-up a Base Station

The next step is to turn on power to the BCGs. The -48 V DC power for each BCG in a rack normally originates from a common source such as an optional Power Distribution Panel (PDP).

Steps

1. Be sure that -48 V DC input power to the PDP is turned on before applying any power to the BCGs or associated equipment.

Warning: Handle -48 V DC cables with extreme caution.

Potentially hazardous and deadly voltages are present.

Improper handling may result in fire, electrical shock, or death.

2. Turn on the switch associated with each BCG, beginning with the Primary BCG and proceeding to the last BCG.

3. The final step is to install the aluminum cover on the front of each BCG.

Note: For more information, please refer to the SP2200 equipment manuals.

This completes -48 V DC connection to a BCG, installation of a BCG chassis & DCDM cards, and power-up for a BCG.



Review Questions


- (1) The BCG comes standard with how many DCDM cards?
- (2) Is the Power Distribution Panel a standard SpectraPoint Wireless part?
- (3) -48 V DC power leads are connected to the terminal lugs on the ____ card.
- (4) The FRO card provides a ____ MHz reference signal to the BCG.
- (5) What is the last step in installation of a BCG?

Slide 3-14

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Review Questions

See slide 3-14 for end-of-section review questions.



Node Installation

Upon completion of this section, the student will be able to discuss the installation of a SP2200 Node:

- Installing a SRIU
- Installing SRIU Plug-in cards
- Assembling a Sector Mounting Frame
- Installing Transmitters and Receivers
 - Mounting the TXs and RXs
 - Aligning the antennas

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Node Installation

This section describes the physical installation of the **SpectraPoint™** SP2200 Node equipment. See slide 4-1 for section objectives. **Note:** *Exact steps are detailed in the SP2200 Node Equipment Manual. The procedures shown are based on the equipment manual.*

Attention: *Before proceeding with the installation, please review all safety, electrical and code compliance notices in the SP2200 Node Installation Manual.*

This information in this section is intended to assist technicians and installers, and assumes the following:

- The student has the skills and training required to assemble and test mechanical, electrical, telecommunications and radio equipment.
- The student has access to the tools and specialized equipment required to install, test and adjust these systems.
- Radio transmission equipment installers, electricians and other contractors hold any licenses required at the installed.

Before You Begin

Site Plan Checklist

Check the Sector sites against the Site Plan and as-built drawings.

- ☐ Locate electrical facilities, including locations of power drops and site-specific installation requirements.
- ☐ Identify where each Frame and SRIU is to be installed, and verify that each location is structurally sound and suitable for installation (make any slight adjustments needed to finalize actual installed location).
- ☐ Verify that there are no LoS (line of sight) obstructions:
 - within $\pm 70^\circ$ azimuth for 10 meters from antenna center line
 - within -45° elevation for 6 meters from antenna center line
- ☐ Verify that all required tools and testing equipment are on-hand. Secure additional items needed.

Equipment Delivery Checklist

Unpack and check system equipment delivered.

- ☐ Check the equipment on-site against the Site Plan list, ensuring that all required items are present: Antenna Frames, SRIUs, Transmitters, and Receivers.
- ☐ Uncrate each Frame and SRIU near its intended mounting location.

Installation Steps

- | | |
|---------------------------------|-------------------|
| • Installing the SRIU | pages 4-4 & 4-5 |
| • Installing SRIU plug-in cards | pages 4-6 & 4-7 |
| • Sector Frame Assembly | pages 4-8 & 4-9 |
| • Mounting TXs and RXs | pages 4-11 & 4-12 |

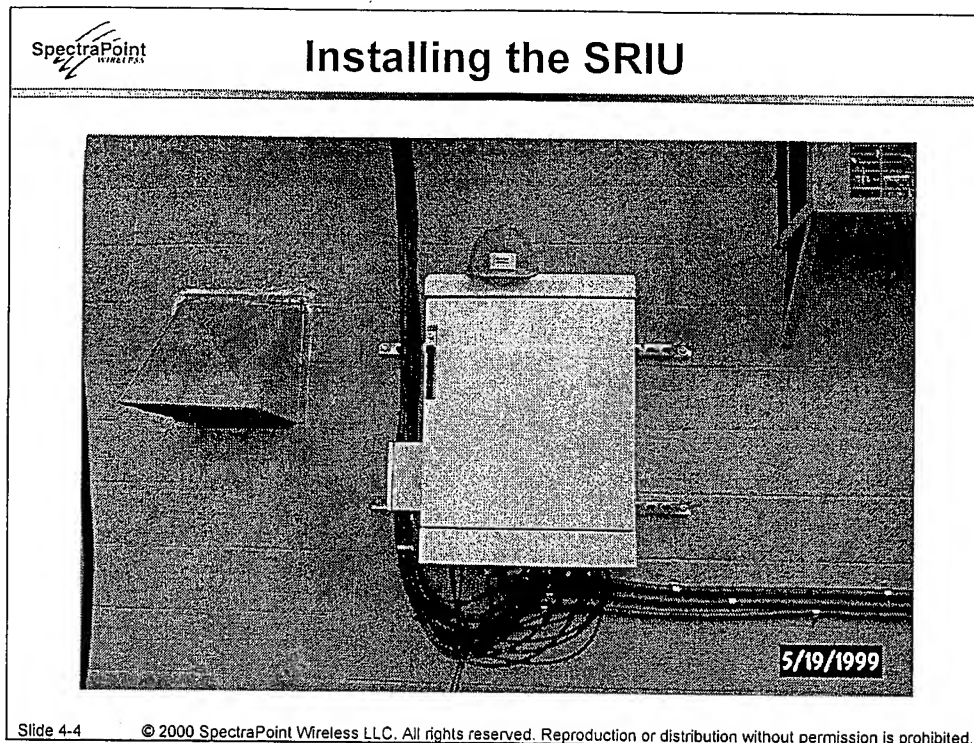
Note - *This training manual does not cover the following items:*

Gaining permission to perform work

Performing work at a Base Station site typically requires securing permission from the building (facilities) management. This process is not reflected in the steps shown.

Securing needed parts

To perform the steps shown in this section require that the parts needed for the installation must be secured before beginning any work. This process is not reflected in the steps shown.



Installing the SRIU

The SRIU is a large component, and must appropriately secured due to size and weight. The mounting used is site-specific for each deployment, and the SRIU may be pole-, wall-, or tower-mounted. Slide 4-4 shows one of these mounting options - an SRIU mounted to the side of an outside structure.

Steps

1. Move the SRIU (crated) near its final mounting location.
2. Unpack the SRIU from its shipping container and shipping bag.
3. Attach yourself to the fall arresting system being used before attempting to mount the unit.

Warnings:

- *Ensure that all fall arresting systems, such as lifelines, body harnesses, and other associated equipment are inspected and properly used.*
- *Do not install an SRIU while there is the threat of lightning, it is raining, or the excessive winds exist.*
- *When installing the unit near power lines, be extremely careful.*
- *Check to be sure the SRIU is securely mounted before working beneath the unit.*

Installing the SRIU

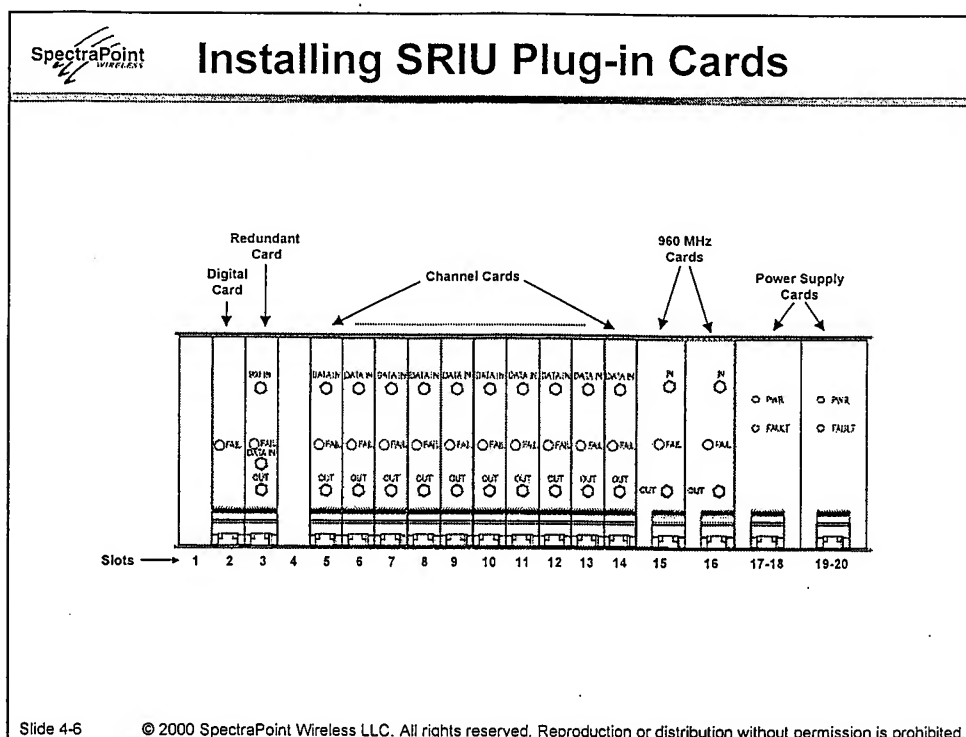
Steps, continued

4. Mount the SRIU in place as shown in the installation plan.
 - Allow 46 cm/18in below the SRIU cabinet for cable exits, and 61 cm/24 in clearance in front of the cabinet door. Allow 16 cm/6 in in front of the Power Box for opening the door.
 - For pole mounting, attach a pole-mounting assembly to the Unistrut™ mounting rails. Attach the SRIU and pole-mount assembly to the pole by wrapping the metal support band around the pole and tighten the bolts.
 - For wall mounting, replace the standard Unistrut™ mounting rails with longer slotted rails*. Drill 16 mm/5/8 in holes at appropriate locations, and secure the SRIU to the wall surface with 16 mm/5/8 in expanding bolts (for brick or concrete) or lag screws (for wood studs) as needed. ***Note:** *The longer rails are available from most electronics supply stores.*
5. Turn on the -48 V DC power source to check the leads. Turn off the power source. Connect the -48 V DC power source to the SRIU.

Warning: *Handle -48 V DC cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.*
6. Follow company procedure for disposition of the shipping material.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for installing a SRIU.



Installing SRIU Plug-in Cards

The SRIU plug-in cards will be shipped separately from the SRIU and must be installed at the time of deployment. The SRIU plug-in cards will be installed in the card cage inside the SRIU as shown in slide 4-6. The drawing on the back of the front door (inside) of the SRIU is a standard high-level diagram and may not fully detail the current status of the installed unit.

Attention:

- Each Channel card slot is assigned a particular frequency which may vary from site to site. Be sure to check card assembly numbers against the installation plan before installing the cards.
- The same applies for the Redundant card. The Redundant card is assigned particular frequencies which must match the channel frequencies of the Channel cards.

Installing SRIU Plug-in Cards

Steps

1. Move the box containing the SRIU Plug-in cards needed near the installed SRIU.
2. Attach an ESD strap to your wrist and to an ESD bond point on the SRIU.

Attention: *Static electricity can damage electronic equipment. Always wear an ESD strap when removing or installing any SRIU Plug-in card.*

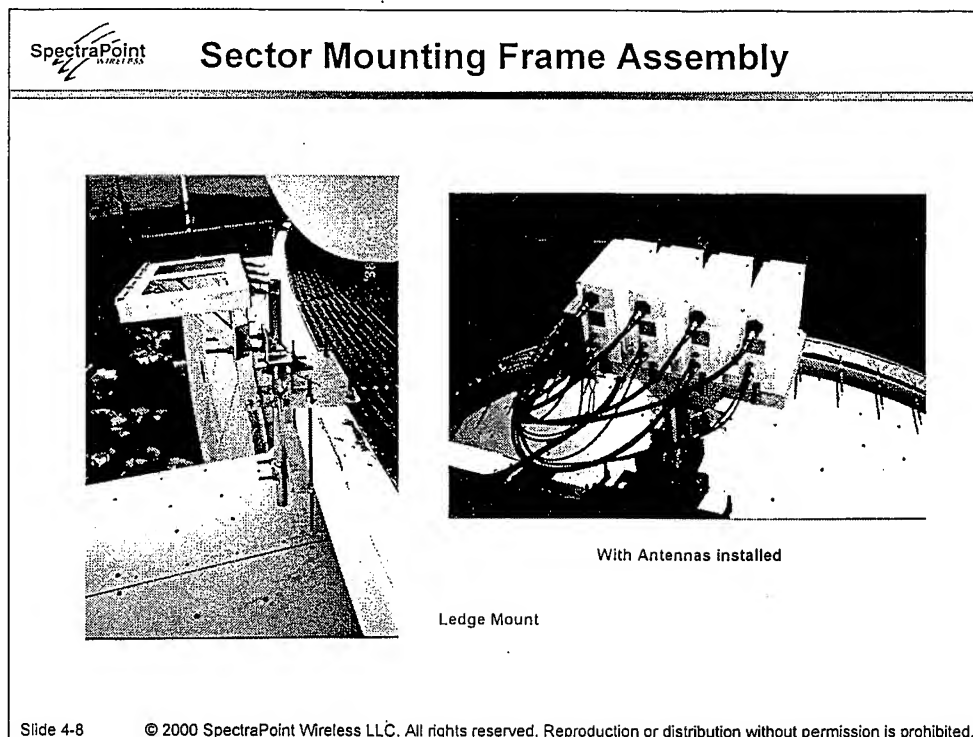
3. Locate the key the SRIU door and unlock it.
4. Identify the correct installation slot for each card per the installation plan.
5. If the SRIU was shipped from the factory with blank plates over the plug-in card slots, identify which slots will be used and remove the blank plates. (optional)
6. Remove a plug-in card from its anti-static bag, and slide it into the correct slot in the card cage per the installation plan, as shown in slide 4-5.

Attention: *Handle the SRIU cards by the faceplate or by the edges of the card. Do not touch connectors or components mounted on the face or back of the card.*

7. Secure the card using the card lock mechanism near the bottom of the card. Tighten the screw on each end of the card.
8. Repeat step #5 and 6 for all cards.
9. Close the door and lock the SRIU.
10. Remove the ESD strap.
11. If this is an additional (new) plug-in card, notify the NOC that the installation has been completed. Provisioning from the NOC may now take place.
12. Follow company procedure for disposition of the shipping material.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for installing a SRIU Plug-in card.



Sector Mounting Frame Assembly

Mounting Frames are available in many different styles to accommodate site-specific requirements; most are custom-made for each installation. Slide 4-8 shows two views of one type of mount assembly. Site-specific assembly and installation instructions are shipped with each Frame.

Placement

Mounting Frames are aimed and installed at 90° azimuths to provide sector mounting for radios. **Note:** *The installation plan indicates the location and azimuth for each Frame.*

Attention:

- *Mount the Frame securely before adding Transmitters and Receivers as high winds can shift an unsecured Frame drastically and suddenly.*
- *Custom painting or enhancement of the mounting frame is acceptable, except for the area directly under each radio (TX/RX). This area must remain the original factory finish and is used for grounding the unit.*

Frame Assembly Procedure

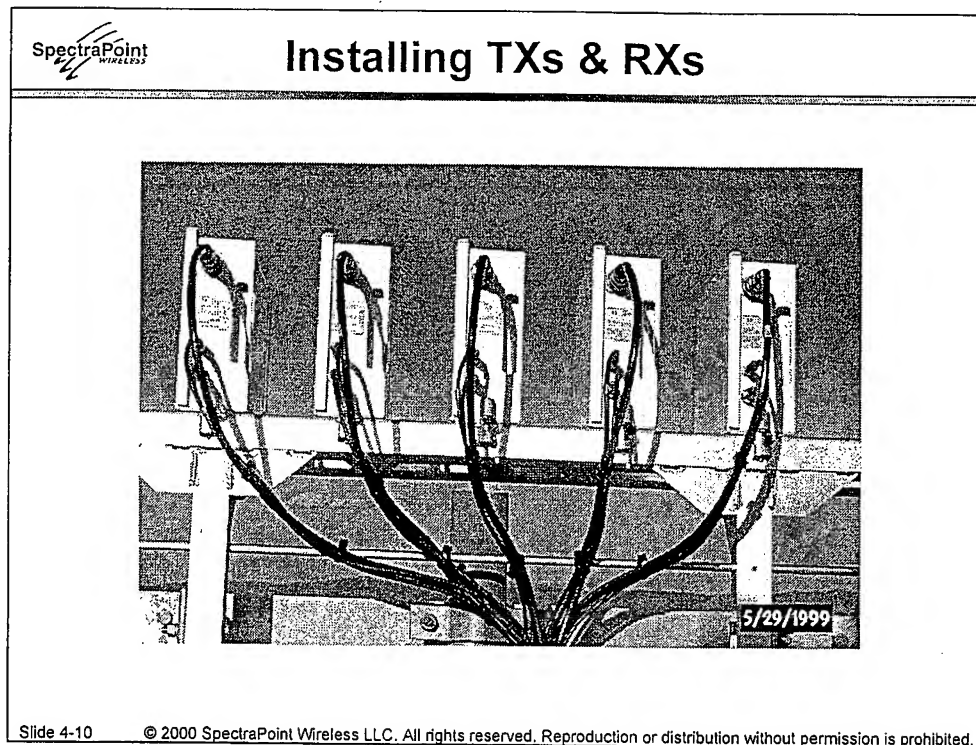
Frame assembly is illustrated in the SP2200 Node Installation Manual. The information listed below is based on that document.

Shown below are generic tasks associated with assembly of a Mounting Frame. **Note:** *Each mounting Frame is designed for site-specific installation. Actual assembly tasks are detailed with each Frame shipped.*

1. Move the frame (crated) near the mounting location.
2. Unpack the frame.
3. Assemble the base of the Frame.
4. Assemble the support sub-structure, including vertical supports.
5. Attach the Frame to the Site structure.
6. Level the Frame and Mounting Platform.
7. Ground the Frame to the building's ground system.
8. Follow company procedure for disposition of the shipping material.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for assembling a Sector Mounting Frame.



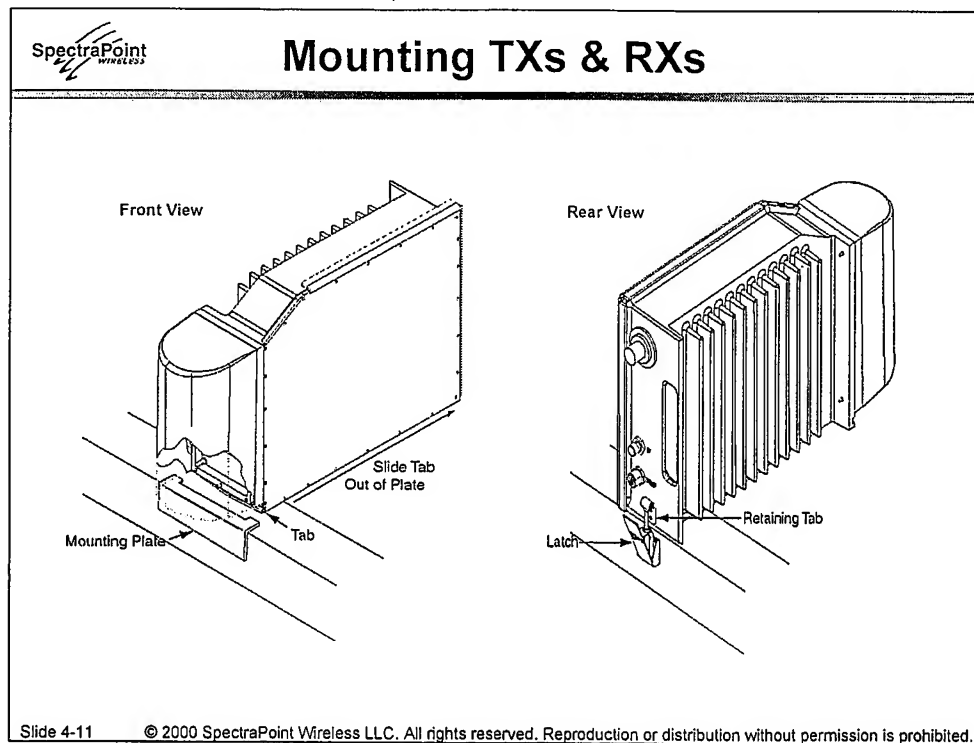
Installing Transmitters and Receivers

A pole-mounted installation of Transmitters (TX) and Receivers (RX) is shown in slide 4-10. **Note:** *The photo shows Basic TX/RX.*

Identifying Transmitters & Receivers

Transmitter and Receiver housings appear identical and use the same type of mounts and connectors; they are identified by a panel label on the rear of the unit that shows the letters 'TX' or 'RX', and a part number: **Note:** *An example of a part number for a Transmitter is "TX2000-28-510-V". Please refer to the current SP2200 Node equipment manual for a full listing of part numbers.*

Attention: *The outside (enclosure) of the the radio must remain as finished from the factory. Any finish other than factory affects the performance of the radio. Customized options are available from SpectraPoint Wireless; see your SpectraPoint sales person for details.*



Installing Transmitters and Receivers, continued

Mounting the Transmitters (TX) and Receivers (RX)

Note: Shown in slide 4-11 is a Basic unit. The procedure for installing a Basic or High Gain radio is the same.

Steps

1. Identify TXs/RXs needed for the mounting frame per the Site installation plan. Move the required number and types of TX/RX next to the mounting frame.
2. Unpack each Transmitter and Receiver to be installed.
3. Place a TX/RX on the Mounting Platform, sitting flat with the radome facing in the direction of the transmission. In this position, all cable connections are in the rear.
4. Align the tab on the front edge of the unit with the mounting plate on the front edge of the mounting platform.
5. Slide the unit into the Mounting Plate, ensuring that the tab on the front of the TX/RX slides under the mounting plate. The unit is correctly positioned when the tab is fully inserted under the mounting plate.

Installing Transmitters and Receivers

Steps, continued

6. Secure the unit by capturing the retaining pin attached to the rear of the unit in the cup of the self-locking retaining clamp. Tighten the clamp until the TX/RX is securely fastened.
7. Repeat the steps above for the other TXs/RXs to be installed on this frame.
8. Follow company procedure for disposition of the shipping material.

Aiming the Transmitters & Receivers

No adjustment of individual antennas is necessary. The TXs/RXs are permanently aligned perpendicular to the horizontal mounting platform.

The antennas are properly positioned when the mounting platform is:

- 1) aimed within 1° of the broadcast azimuth
- 2) level across the platform width
- 3) pointed 1° below horizontal along the transmission axis for the Basic antenna, or pointed 0° if it is a High Gain antenna

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the installation of the Node equipment: Sector Radio Interface Unit (SRIU), SRIU plug-in cards, Mounting Frame, and radios (Transmitters and Receivers).



Review Questions

- (1) Can the SRIU be mounted on a pole?
- (2) How much clearance is needed in front of the SRIU? How much below the unit is needed?
- (3) Any Plug-in channel can be installed in any slot in the SRIU. True or False?
- (4) What is the painting restriction on the sector mounting frame?
- (5) There is one standard way to mount TXs/RXs. True or False?
- (6) What is the procedure for adjusting an individual antenna?

Slide 4-13

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Review Questions

See slide 4-13 for end-of-section review questions.



Base Station Cabling

Upon completion of this section, the student will be able to discuss the cabling of a SP2200 Base Station:


- Base cabling
 - DS-3 connection to BCG
 - BCG to CGC
 - Cabling multiple BCGs
- Node cabling
 - CGC to building entry
 - SRIU to building entry
 - Lightning grounding protection
 - SRIU to CGC connections
 - SRIU to TXs/RXs

Slide 5-1

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Base Station Cabling

This section provides an overview of the cabling needed to install the **SpectraPoint™** SP2200 Base Station. This information is shown by installed equipment, including Base Channel Groups (BCGs), Channel Group Combiner (CGC), Sector Radio Interface Units (SRIUs), Transmitters, Receivers, and associated components. See slide 5-1 for section objectives. **Note:** *For exact cabling procedures refer to the SP2200 equipment manuals and the Site Preparation Guide. The procedures shown are based on the equipment manuals and the guide.*



Base Station Cabling

- Base cabling
 - DS-3 Connection to BCG
 - BCG to the CGC
 - Cabling multiple BCGs
- Node cabling
 - CGC to SRIU
 - Lightning grounding protection
 - Building entry to SRIU
 - SRIU to TX/RX

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Base Station Cabling

Base Station cabling tasks are shown in slide 5-2, and the outlined in the pages listed below.

Base cabling

- DS-3 Connection to BCG page 5-4
- BCG to the CGC page 5-5
- Cabling multiple BCGs page 5-6

Node cabling

- CGC to building entry page 5-7
- Lightning grounding protection page 5-8
- Building entry to SRIU page 5-8
- SRIU to CGC connections page 5-9
- SRIU to TXs/RXs pages 5-10 & 5-11

Addendum

pages 5-13 to 5-16

- Transport Connections, Connectors, Port pinouts

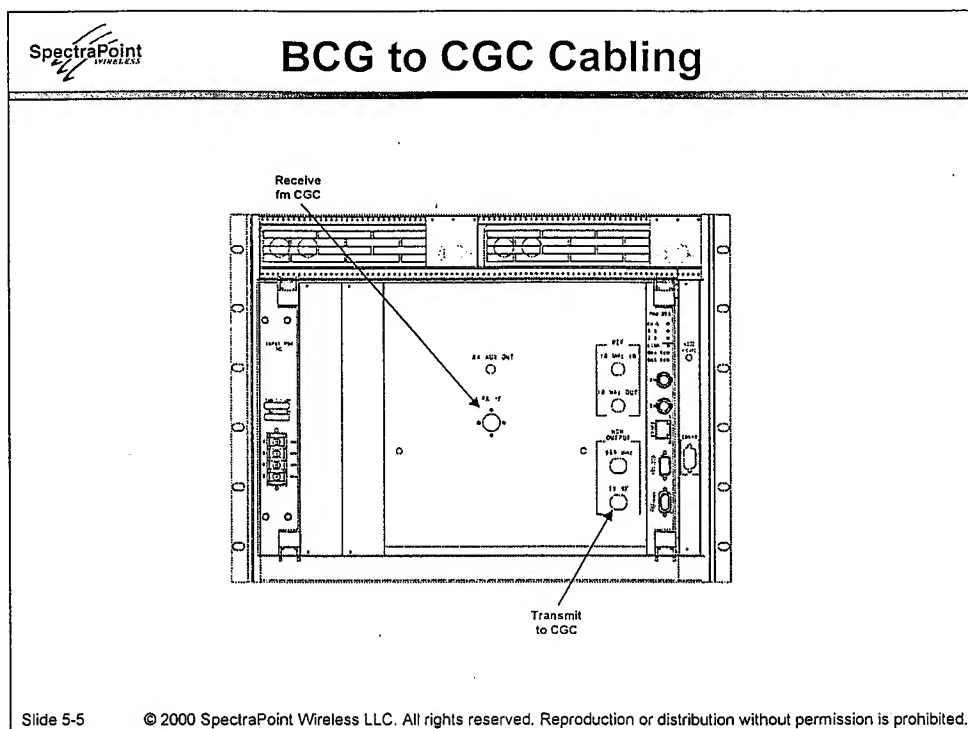
Note - *This training manual does not cover the following items:*

Gaining permission to perform work

Performing work at a Base Station site typically requires securing permission from the building (facilities) management. This process is not reflected in the steps shown.

Securing needed parts

To perform the steps shown in this section require that the parts needed for the installation must be secured before beginning any work. This process is not reflected in the steps shown.



BCG to CGC Cabling

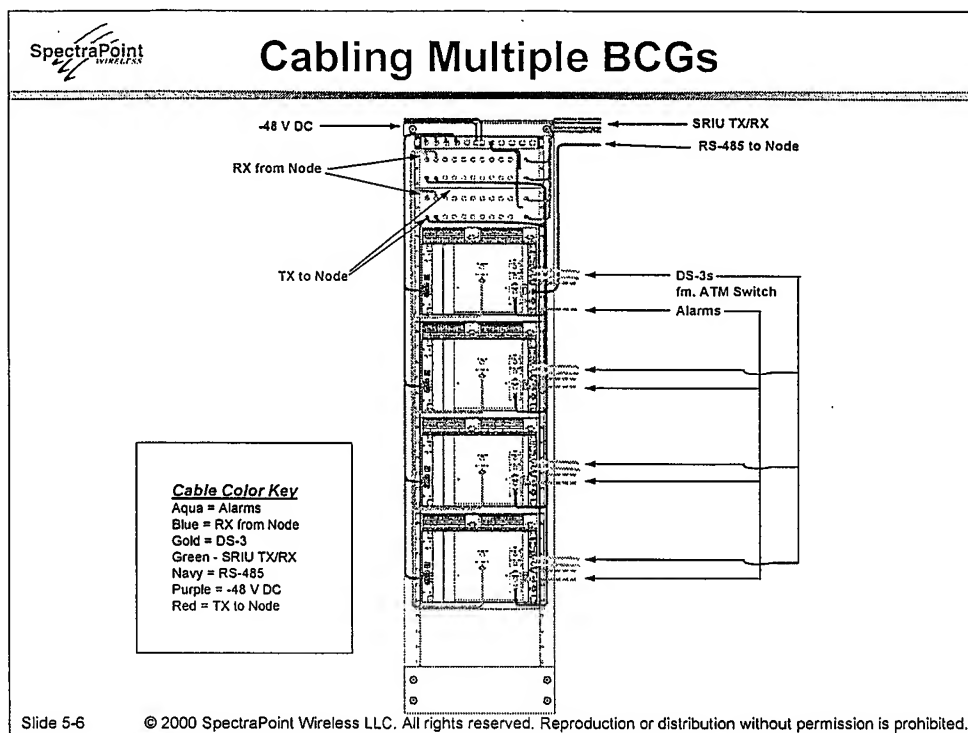
One Channel Group Combiner (CGC) is used with each sector, and the CGC is installed in the Primary (first) rack in the sector at the Base. Two Intermediate Frequency (IF) coaxial cables are required from each Base Channel Group to the CGC: one cable for IF output of the BCG (*Transmit*) to the CGC and one cable for IF input to the BCG (*Receive*) from the CGC

Steps

1. Identify the ports on the CGC for the BCG being cabled to.
2. Route two coaxial cables for one BCG, cut to length, and crimp each end with the correct terminal.
3. Connect the end of one cable to the RX IF port on the BCG and the other end to the correct TX port on the CGC.
4. Connect the end of the other cable to the TX IF port on the BCG and the other end to the correct RX port on the CGC.
5. Repeat steps 2 - 4 for each BCG in the sector.

Note: For more information, please refer to the SP2200 equipment manuals.

This completes the procedure for cabling a BCG to CGC.



Cabling Multiple BCGs

When multiple Base Channel Groups (BCGs) are deployed at the Base to provide LMDS services, the correct method of the BCGs must be used. Slide 5-6 shows the correct cabling for 4 BCGs.

Note: Although 4 BCGs are shown, a fully populated sector could be deployed in two 2.1 m/7 ft racks. Using this method, each rack would have 5 BCGs.

All BCGs in the same sector will input to the same Channel Group Combiner (shown at the top of the rack in the slide). A chart on PMD connectors is shown on page 5-14. The pinouts for Ethernet port and RS-232 port are on page 5-15. More details may be found in the SP2200 equipment manuals.

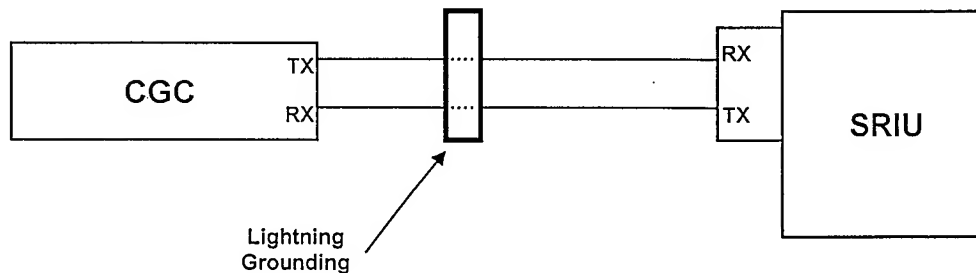
Attention: The drawing is for illustration only, and shows the RX IF cables run along side the -48 V DC cable. However, all IF cables should be routed away from any power cables.

Cabling from the CGC to the SRIU

The Channel Group Combiner (CGC) is connected to the Sector Radio Interface Unit (SRIU) with two cables - one for Transmit (TX) to the SRIU, and one for Receive (RX) from the SRIU.

The coaxial/fiber cables will be run from the CGC to the building cable entrance (bulkhead) location, grounded, and routed to the SRIU on the roof.

Attention: All cables from the CGC to the SRIU must be grounded at the point of building entry. This is most commonly done using a Lightning Protection Panel or cable shielding.



CGC to Building Entry Cabling

Note: The Transmit (TX) and Receive (RX) cables are built on-site during the deployment.

Steps

1. Route two coaxial cables from the CGC to the building entry point, cut to length, and crimp each end with the correct terminal.
2. Mark both ends of one cable as RX and both ends of the other as TX.
3. Connect the end of the RX cable to the RX port on the CGC and the other end to the correct port on the grounding apparatus.
4. Connect the end of the TX cable to the TX port on the BCG and the other end to the correct port on the grounding apparatus.

Attention: Be sure to connect the TX cable to the TX entry point, and the RX cable to the RX entry point. Connecting these cables incorrectly will result in communication failure or equipment failure.

Lightning Grounding Protection

Correct grounding for the Base and Node includes the following:

- The cable entrance (bulkhead) must be weather tight.
- The design used will be site-specific, as needed to satisfy Node deployment requirements.
- Use a minimum 14 AWG copper wire or 12 AWG aluminum wire from the grounding block/plate to the building ground point.
- Cables should be labeled on both ends to indicate part number, equipment, connector type and connector number (JXX). The labels are typically white with black type, located approximately 19 mm³/₄ in from the connector.

Note: *The grounding method used will be site-specific. Please follow manufacturer's instructions for installation.*

Building Entry to SRIU Cabling

Note:

- *The Transmit (TX) and Receive (RX) cables are built on-site during the deployment.*
- *The SRIU connection points at the SRIU power box are discussed on page 5-9.*

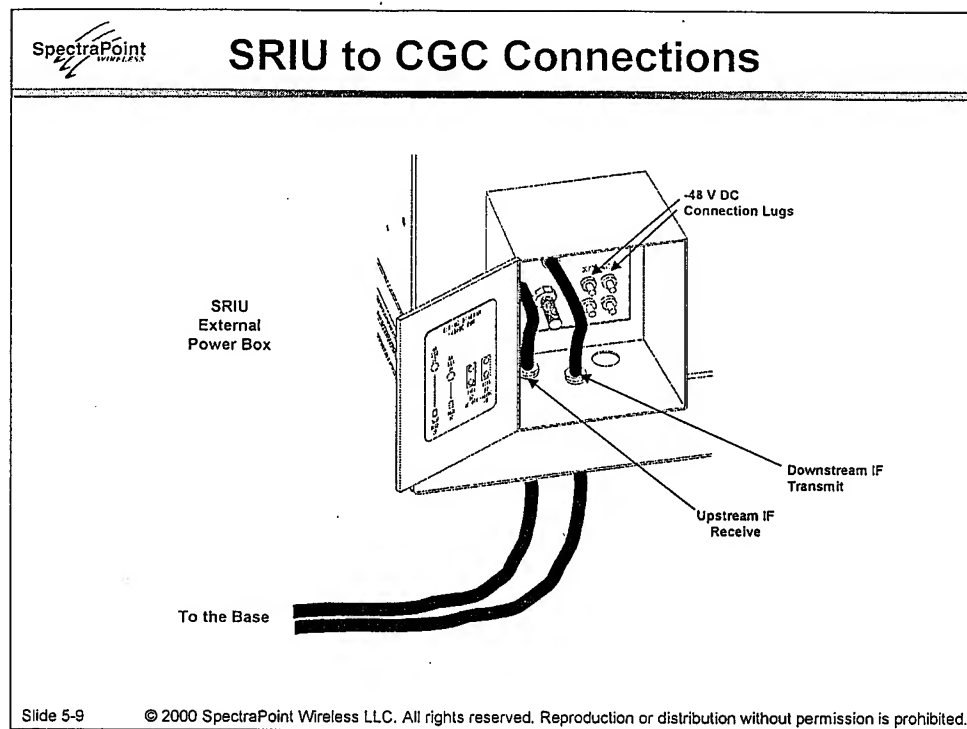
Steps

1. At the roof, route two coaxial cables from the building entry point to the SRIU and cut to length. Install N-type connectors and crimp each end.
2. Mark both ends of one cable as RX and both ends of the other as TX.
2. Connect the end of one cable to the RX port in the SRIU power box and the other end to the correct port on the grounding apparatus.
3. Connect the end of the other cable to the TX port in the SRIU power box and the other end to the correct port on the grounding apparatus.

Attention: *Be sure to connect the TX cable to the TX entry point, and the RX cable to the RX entry point. Connecting these cables incorrectly will result in communication failure or equipment failure.*

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for cabling from the CGC to SRIU.



SRIU to CGC Connections

As shown in slide 5-9, the IF cables and the -48 V DC power connects to the SRIU at the Power Box on the side of the SRIU.

IF Connections

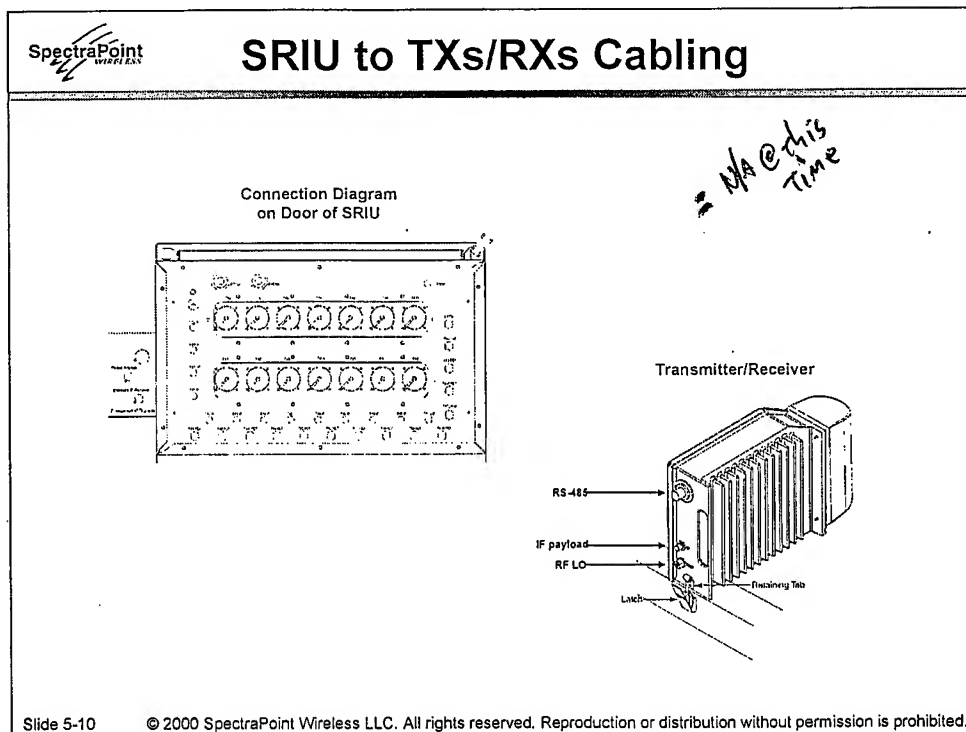
The IF coaxial cable connectors are on the bottom of the SRIU external power box, and are marked Upstream and Downstream.

Attention: Coaxial cables from the CGC connect direct to the IF connectors. When using fiber, the fiber cables will connect to a fiber optic receiver to convert from optical to electrical, and then connect to the SRIU using coaxial.

-48 V DC Input

-48 V DC is connected to the SRIU inside the power box to the lugs as shown in the slide. The source for the -48 V DC may be the Power Conversion Unit (PCU) that serves the BCGs for the sector or it may be provided a independent source on the roof.

Warning: Handle -48 V DC cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.



SRIU to Transmitters and Receivers Cabling

The cables from each TX/RX to the SRIU listed on the Site Plan are connected from the TX/RX to the SRIU at the designated port on the SRIU bulkhead. Slide 5-10 shows a diagram for the SRIU bulkhead panel (left side) and a TX/RX (right). The three cables for each TX/RX are routed as needed to meet site needs.

- Payload L-band IF from the Base uses coaxial cable.
- Local Oscillator (LO) reference uses coaxial cable.
- RS-485 control signals are carried on a separate multi-pair cable from the Primary BCG to the SRIU, and carries power for the antenna also.
- Lightning grounding to the SRIU is made to a stud on the bulkhead panel.

Steps

1. Lay out the cables for one antenna in the frame.
2. Terminate the each end of the cable as required (payload coax with TNC connector, RS-485/power with 18-pin bayonet connector, and LO reference with N-type connector).

SRIU to Transmitters and Receivers Cabling

Steps, continued

Warning: Handle -48 V DC (RS-485/power) cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.

Attention: The TNC connectors are being replaced with N-type connectors on all new radios, both Basic and High Gain.

3. Connect each cable to the correct port in the bulkhead panel per the wiring diagram on the door of the unit.
4. Connect the corresponding end of each cable to the correct port at the TX/RX.
5. Repeat this procedure for each TX/RX in the frame (sector) until all are cabled.
8. Dress all cables as needed, and apply sealants and termination boots as per local practice.
9. Turn on -48 V DC power to the SRIU.

Note: For more information, please refer to the SP2200 equipment manuals.

This completes the procedures for all Base and Node cabling.



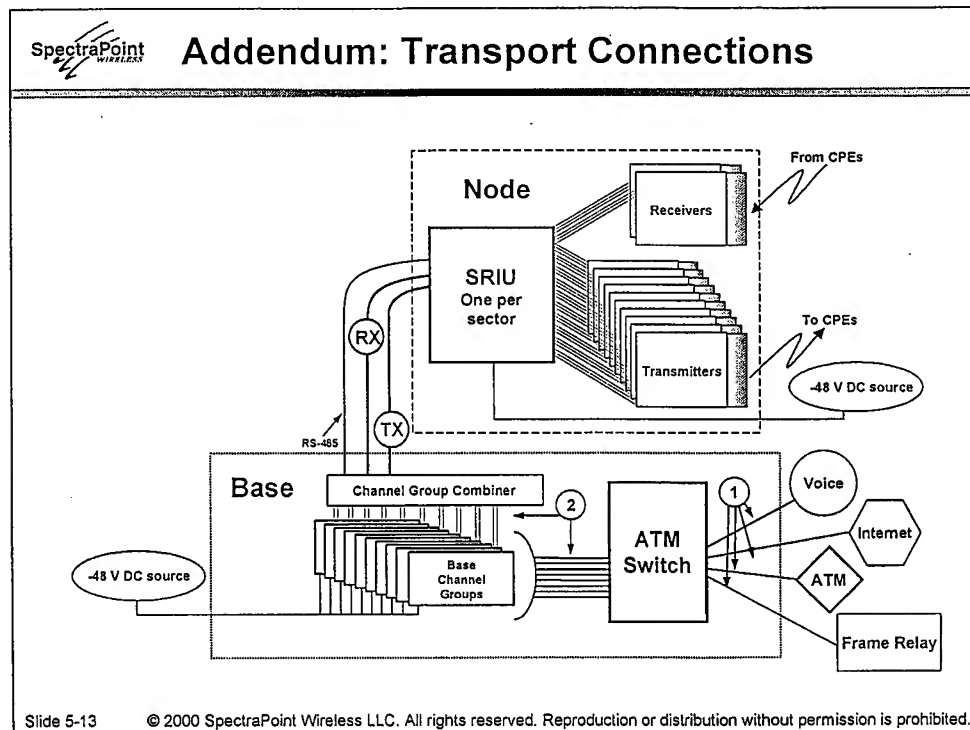
Review Questions

- (1) How is the DS-3 connected to the BCG?
- (2) Is the RS-485 from each BCG connected to the SRIU?
- (3) Cables from the CGC to SRIU may be grounded using a Lightning Protection Panel. True or False?
- (4) How many cables are used between the Base and the Node?
- (5) -48 V DC power is connected to the SRIU where?
- (6) Transmitters have three connections - name them.

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Review Questions

See slide 5-12 for end-of-section review questions.



Addendum: Transport Connections between the Source, Base, and Node

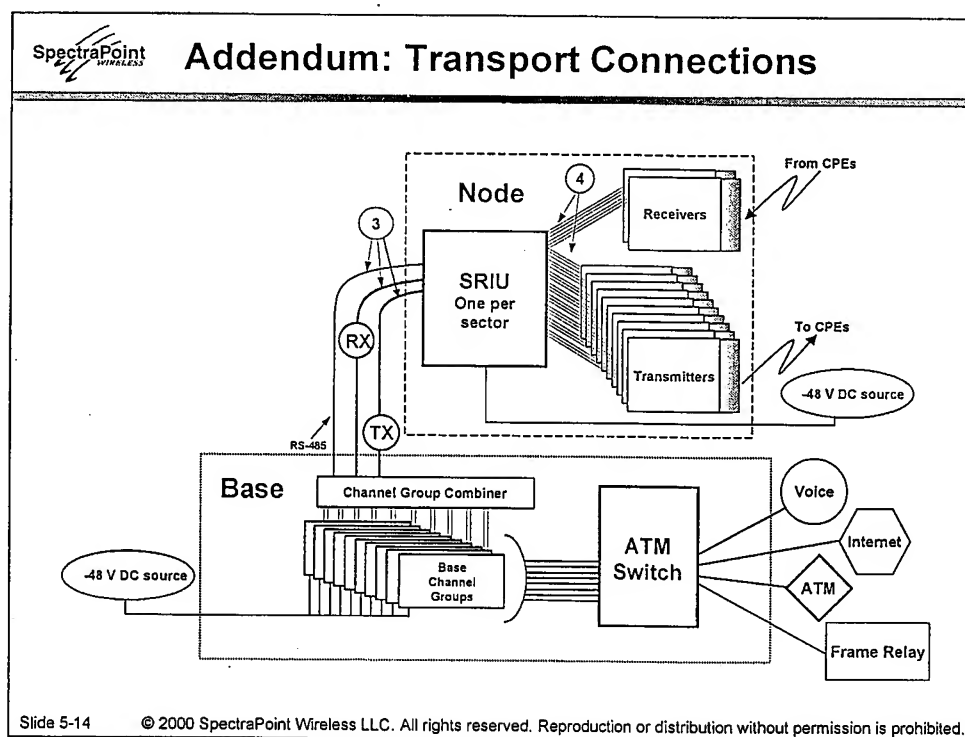
The numbers shown in circles in slide 5-13 reference the numbers shown below.

1. Inputs to ATM switch

- Voice from PSTN
- Internet from ISPs
- Private data network connections
 - Frame Relay
 - ATM

2. Base Channel Group (BCG)

- Input to each BCG is DS-3 ATM link from the Network Access Switch to BCG.
- Each BCG is connected to Channel Group Combiner (CGC) with 2 coaxial cables - one for TX and one for RX.



Addendum: Transport Connections between the Source, Base, and Node, cont'd.

The numbers shown in circles in slide 5-14 reference the numbers shown below. **Note:** Cables from the CGC to the SRIU and from the SRIU to each radio (TX and RX) are built on site.

3. CGC (Base) to SRIU

- One IF Payload TX (coaxial or fiber cable)
 - IF payload
 - Pilot Tone/Local oscillator (LO)
- One IF Payload RX (coaxial or fiber cable)
- One 4-wire RS-485 cable from Primary BCG for Base to Node control

4. SRIU to each Transmitter or Receiver:

- One coax cable for IF Payload
- One multi-pair cable for RS-485 and -48 V DC
- One coax cable for Pilot Tone/Local Oscillator (until RTU 2.0)

Addendum: BCG Connectors

Note: In the chart below M is male, F is female.

Connector Label	Connector Type	Cable Type	Connects To
A -48 V	Screw terminal	14 AWG or larger insulated copper wire (red)	Power Supply -48 V DC supply
A RTN	Screw terminal	14 AWG or larger insulated copper wire (black)	Power Supply Return
B -48 V	Screw terminal	14 AWG or larger insulated copper wire (red)	Power Supply -48 V DC supply
B RTN	Screw terminal	14 AWG or larger insulated copper wire (black)	Power Supply Return
RX IF	N-type F	50Ω Heliax coax	CGC (or SRIU at Node in single BCG installations)
REF: 10 MHz IN 10 MHz OUT	Both BNC F	Both 50Ω Heliax coax	Not used
HSM OUTPUT: 960 MHz TX IF	N-type F N-type F	50Ω Heliax coax 50Ω Heliax coax	Test port CGC (or SRIU at Node in single BCG installations)
ENVIR	DB-9 F	Supplied by customer	Environmental Alarm indicators or sensors (Optional)
Safety GND	Double lug terminal	10 AWG or larger insulated copper wire (green)	
PMD Ports			
DS-3 Transmit (TX), Receive (RX)	Both BNC F	RG-59 coaxial cable (75 Ω)	ATM Switch TX/RX port (max 137 m/450 ft)
ETHER	RJ-45 F	Unshielded Twisted Pair	Customer's Ethernet hub and/or CID
RS-485	DB-9 F	8- or 9-wire discrete	RS-485
RS-232	DB-9 M	8- or 9-wire discrete	RS-232

Addendum: Port Pinouts

PMD Ethernet ports (RJ-45)

Pin	Name	Function
1	TX +	Transmit Positive
2	TX -	Transmit Negative
3	RX +	Receive Positive
4	Not used	--
5	Not used	--
6	RX -	Receive Negative
7	Not used	--
8	Not used	--

RS-232 ports (PMD DB-9 M, CCCP DB-9 F)

Pin	Name	Function
1	DCD	Data Carrier Detect
2	RD	Receive Data Line
3	TD	Transmit Data Line
4	DTR	Data Terminal Ready
5	GND	Ground
6	DSR	Data Set Ready
7	RTS	Request To Send
8	CTS	Clear To Send
9	RI	Ring Indicator

Note: In the chart above M is male, F is female.



Base Station Maintenance

Upon completion of this section, the student will be able to discuss the maintenance of a SP2200 Base Station:

- Base
 - Replacing a BCG components
 - > CCCP, FRO, HSM, and DCDM cards
 - > DC Supply card
 - > PMD card
 - > DC Input panel
 - Replacing a BCG chassis
 - Replacing a Channel Group Combiner (CGC)
- Node
 - Replacing SRIU Plug-in cards
 - Replacing a SRIU unit
 - Replacing a TX/RX
- Replacement of Base Station cabling

Slide 6-1

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Base Station Maintenance

This section describes unscheduled maintenance procedures for the **SpectraPoint™** SP2200 Base Station. See slide 6-1 for section objectives.

Replacement procedures shown in this section are listed on pages 6-3 and 6-4; exact steps are covered in the SP2200 equipment manuals. The procedures shown are based on the equipment manuals. **Note:** *This section does not include troubleshooting. Troubleshooting is covered in a separate training course.*

Attention:

- *Service procedures for the ATM switch are not covered in this document. Any ATM switch service must be performed by vendor personnel.*
- *Read the Important Safety Instructions in the introductory sections of the SP2200 Base Channel Group Equipment Manual before opening or working on SpectraPoint™ SP2200 Base equipment. Follow the instructions and adhere to all warnings on the product and in the documentation provided.*
- *All maintenance performed must comply with local building, electrical, and fire codes.*

Service Guidelines

Local Code compliance

All service performed will comply with local building, electrical, and fire codes.

Tools and Equipment Needed

Service procedures include removing and installing of field-replaceable parts. A standard electronic technician's tool kit is required, and a grounding strap must be provided and worn during installation or removal of any static-sensitive parts. Crimping tools & terminals for N-type coax, 9-pin D-type connectors, and terminal lugs [both power & ground] may also be required.

Warning: *Use only replacement parts recommended by the manufacturer. Unauthorized substitutions may result in fire, electrical shock, or other hazards and will void warranties.*

Note: *This training manual does not cover the following items:*

Work orders

The procedure for issuing the work order to perform maintenance at any Base Station site is not detailed in the steps shown. The order will normally come from a Network Operation Center (NOC), or the agency in charge of network monitoring and control, and this order will be unique to the body issuing this order. This process is not reflected in the steps shown.

Gaining permission to perform work

Performing work at a Base Station site typically requires securing permission from the building (facilities) management. This process is not reflected in the steps shown.

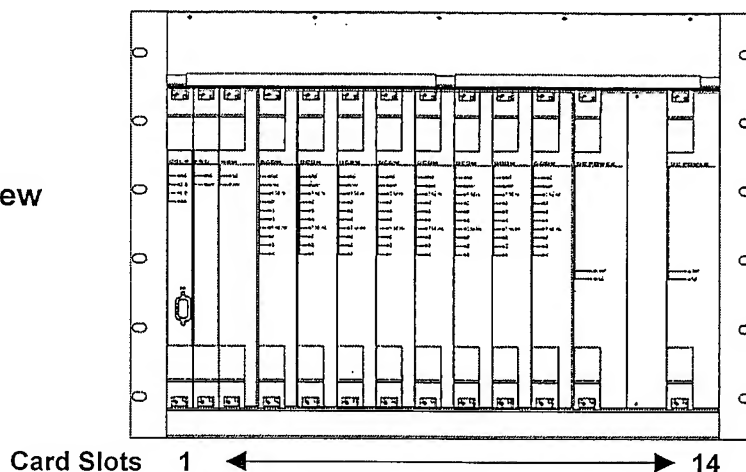
Securing needed parts

To perform the steps shown in this handbook require that the parts needed for the maintenance must be secured before beginning any work. This process is not reflected in the steps shown.

Unscheduled Base Maintenance

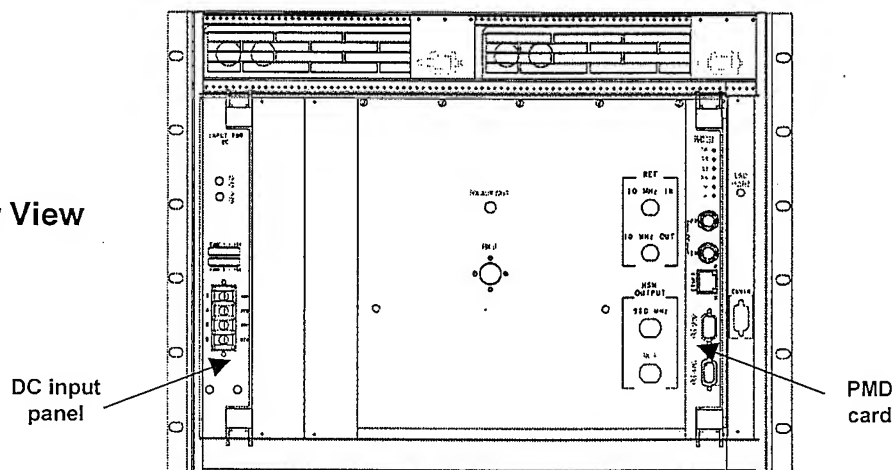
Replacement procedures for the Base are listed below.

BCG Front View



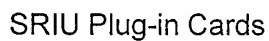
CCCP card	slot 1	pages 6-5 & 6
FRO card	slot 2	pages 6-5 & 6
HSM card	slot 3	pages 6-5 & 6
DCCDM card	slots 4-11	pages 6-7 & 8
DC Supply card	slots 12 & 14	pages 6-9 & 10

BCG Rear View



PMD card	pages 6-11 & 12
DC input panel	pages 6-13 & 14
BCG unit	pages 6-15 & 16
Channel Group Combiner	pages 6-18 & 19

Replacement procedures for the Node are listed below.

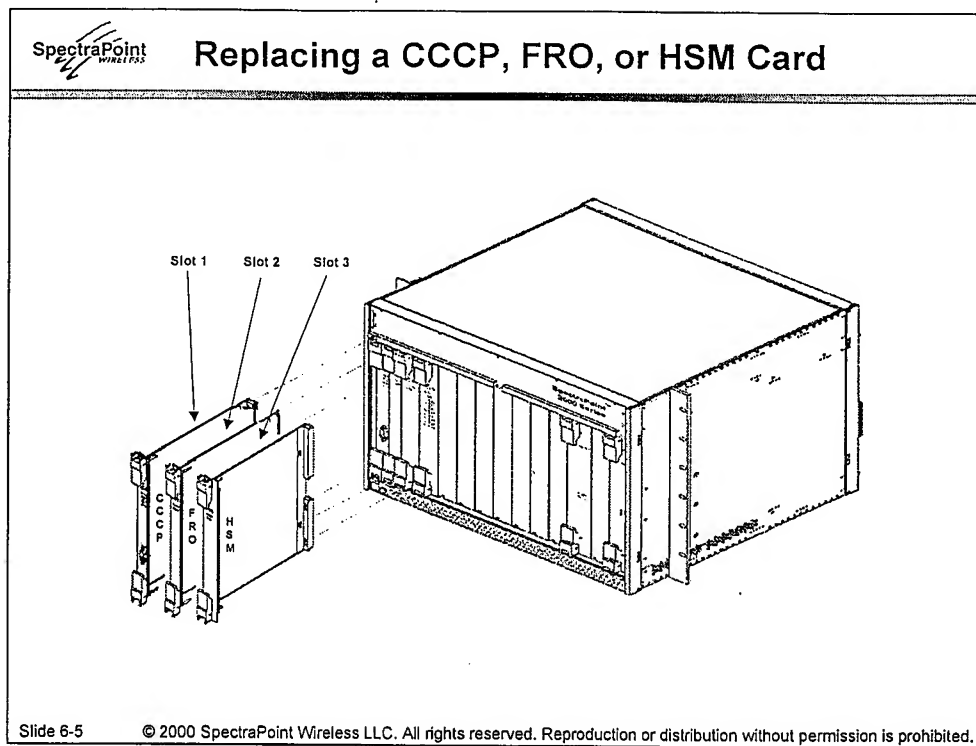


pages 6-20 & 21



pages 6-22 & 23
pages 6-24 to 28

pages 6-29 & 30



Replacing a CCCP, FRO, or HSM Card

Attention: *The CCCP, FRO, and HSM cards are hot swappable. However, these cards provide common functionality for the BCG and removing and replacing one of these cards interrupts service for all customers served by the BCG. Always notify the Network Operations Center (NOC), notify all affected customers, and accomplish the replacement as quickly as possible following all steps.*

Steps

1. Alert the NOC that maintenance is being performed.
2. Identify the card to be replaced per the work order.
3. Attach an ESD strap to your wrist and to an ESD bond point on the equipment rack.

Attention: *Static electricity can damage electronic equipment. Always wear an ESD strap when removing or installing any BCG circuit card.*

4. Remove the cover from the front of the BCG.

Replacing a CCCP, FRO, or HSM Card

Steps, continued

5. Undo the latches on the top and bottom of the card. Remove the old card.

6. Open the shipping box, remove the new card from its anti-static bag, and slide it into the correct slot in the BCG as shown in slide 6-5.

- CCCP card in slot 1
- FRO card in slot 2
- HSM card in slot 3

Attention: *Handle the card by the faceplate or by the edges of the card only. Do not touch connectors or components mounted on the face or back of the card.*

7. Firmly seat the card in the backplane, and snap the card latches in place.

8. Replace the cover on the front of the BCG.

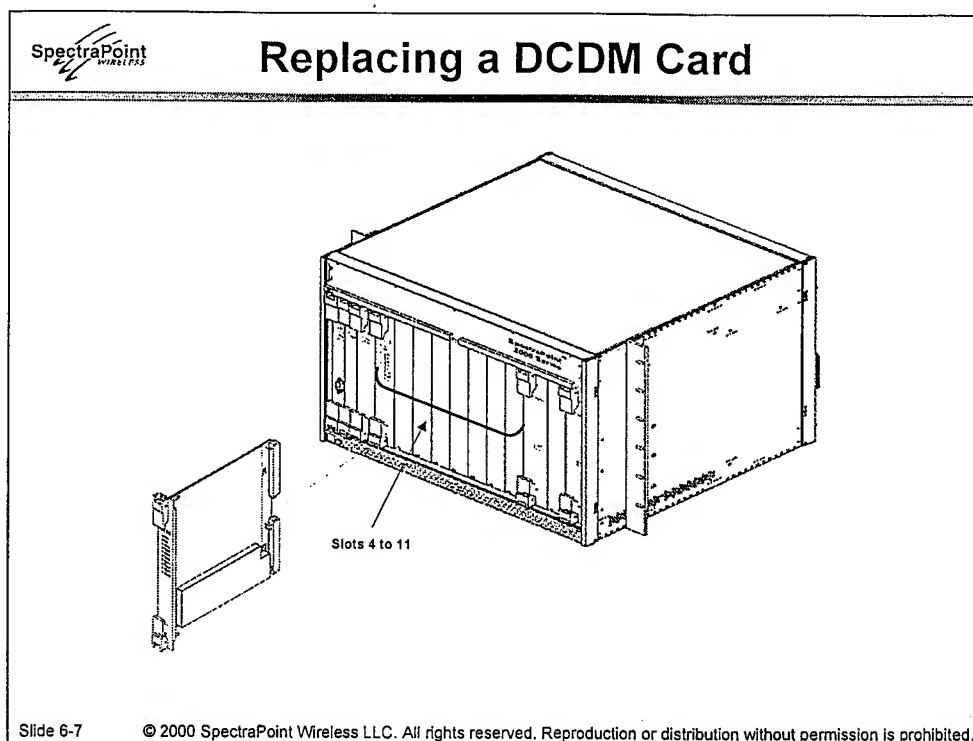
9. Remove the ESD strap.

10. Notify NOC of completion. **Note:** *Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.*

11. Place the old card in the anti-static bag and shipping box. Mark its status. Follow company procedure for disposition of the card.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for replacing a CCCP, FRO, or HSM card.



Replacing a DCDM Card

Attention:

- DCDM cards are hot swappable, and removing one card does not affect traffic on other DCDM cards in the Base Channel Group.
- However, removing and replacing a DCDM card interrupts service for all customers served by this card (4 customers maximum). Always notify the Network Operations Center (NOC), notify all affected customers, and accomplish the replacement as quickly as possible following all steps.

Steps

1. Alert the NOC that maintenance is being performed.
2. Identify the card to be replaced per the work order.
3. Attach an ESD strap to your wrist and to an ESD bond point on the equipment rack.

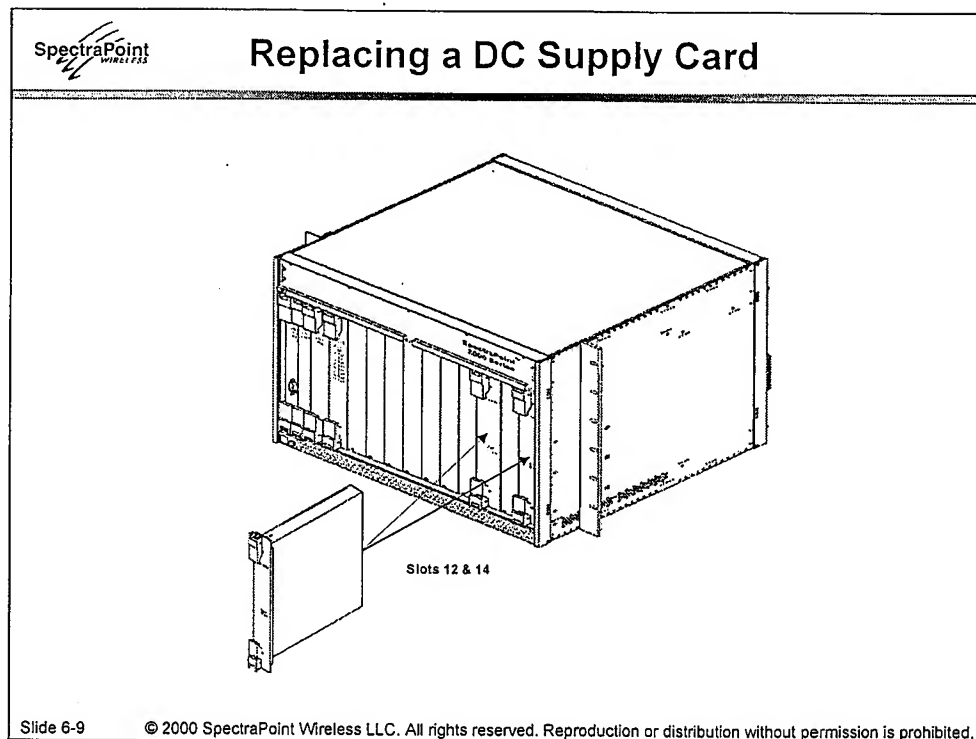
Attention: Static electricity can damage electronic equipment. Always wear an ESD strap when removing or installing any DCDM card.

Replacing a DCDM Card

Steps, continued

4. Remove the cover from the front of the BCG.
5. Undo the latches on the top and bottom of the card. Remove the old DCDM card.
6. Open the shipping box, remove the new DCDM card from its anti-static bag and slide it into the card slot in the BCG as shown in slide 6-7.
Attention: *Handle the DCDM card by the faceplate or by the edges of the card only. Do not touch connectors or components mounted on the face or back of the card.*
7. Firmly seat the card in the backplane, and snap the card latches in place.
8. Replace the cover on the front of the BCG.
9. Remove the ESD strap.
10. Notify NOC of completion. **Note:** *Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.*
11. Place the old DCDM card in the anti-static bag and shipping box. Mark its status. Follow company procedure for disposition of the card.
Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for replacing a DCDM card.



Replacing a DC Supply Card.

Attention: *The DC Supply cards are hot swappable, and one DC Supply card may be removed and replaced without affecting the operation of the other DC Supply card or BCG.*

Steps

1. Alert the NOC that maintenance is being performed.
2. Identify the DC Supply card to be replaced per the work order.
3. Attach an ESD strap to your wrist and to an ESD bond point on the equipment rack.

Attention: *Static electricity can damage electronic equipment. Always wear an ESD strap when removing or installing a BCG power supply card.*

4. Remove the cover on the front of the BCG.
5. Undo the latches on the top and bottom of the card. Remove the old power supply card.

Replacing a DC Supply Card

Steps, continued

6. Open the shipping box, remove the new DC Supply card from its anti-static bag, and slide it into the correct slot in the BCG as shown in slide 6-9.

Attention: *Handle the card by the faceplate or by the edges of the card only. Do not touch connectors or components mounted on the face or back of the card.*

7. Firmly seat the card in the backplane, and snap the card latches in place.

8. Replace the cover on the front of the BCG.

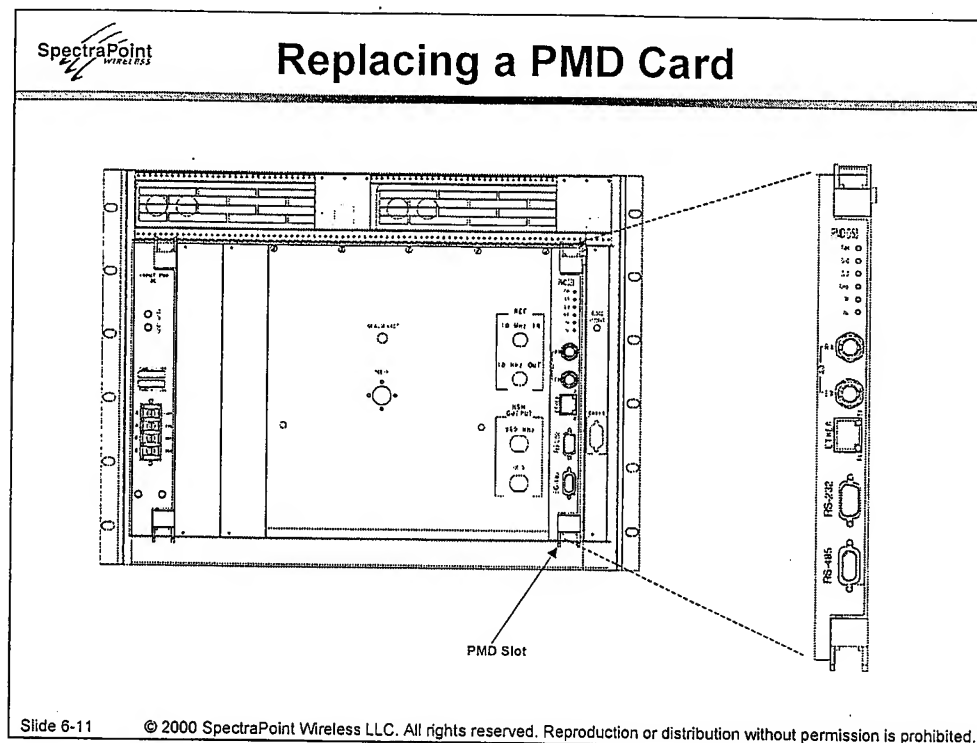
9. Remove the ESD strap.

10. Notify NOC of completion. **Note:** *Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.*

11. Place the old DC Supply card in the anti-static bag and shipping box. Mark its status. Follow company procedure for disposition of the card.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for replacing a DC Supply Card.



Replacing a Physical Medium Dependent (PMD) Card

Attention: Removing and replacing a PMD card interrupts service for all customers served by the BCG. Always notify the Network Operations Center (NOC), notify all affected customers, and accomplish the replacement as quickly as possible following all steps.

Steps

1. Alert the NOC that maintenance is being performed.
2. Identify the PMD card to be replaced per the work order. **Note:** *If the Built-in Test (BIT) has failed, the 'fail' LED should be illuminated solidly (red).*
3. Attach an ESD strap to your wrist and to an ESD bond point on the equipment rack.

Attention: Static electricity can damage electronic equipment.
Always wear an ESD strap when installing a PMD card

Replacing a PMD Card

Steps, continued

4. Disconnect the cables to the PMD card. This includes the TX and RX DS-3 coaxial cables from the ATM switch, as well as Ethernet, RS-232, and RS-485 cables. Be sure that all cables are clearly labeled to facilitate reconnection.

6. Remove the PMD card by loosening the screws on the top and bottom of the card front, and slide the card out of the BCG.

7. Open the shipping box, remove the new PMD card from its anti-static bag, and slide it into the correct slot of the BCG shelf as shown in slide 6-11.

Attention: *Handle the card by the handles on the card front or by the edges of the card only. Do not touch connectors or components mounted on the face or back of the card.*

8. Firmly seat the card in the backplane connector, and tighten the screws on the top and the bottom of the card.

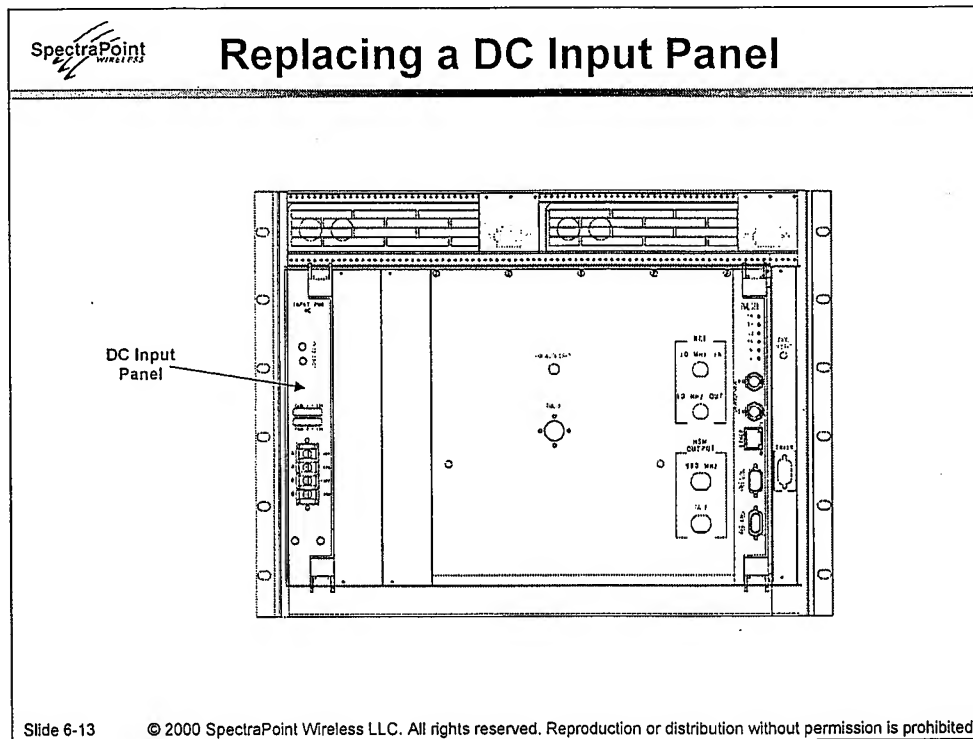
9. Remove the ESD strap.

10. Notify NOC of completion. **Note:** *Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.*

11. Place the old PMD card in the anti-static bag and shipping box. Mark its status. Follow company procedure for disposition of the card.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for installing a PMD card.



Replacing a DC Input Panel

Attention: *Removing and replacing a DC input panel interrupts service for all customers served by the BCG. Always notify the Network Operations Center (NOC), notify all affected customers, and accomplish the replacement as quickly as possible following all steps.*

Steps

1. Alert the NOC that maintenance is being performed.
2. Identify the DC input panel to be replaced per the work order.
3. Attach an ESD strap to your wrist and to an ESD bond point on the equipment rack.

Attention: *Static electricity can damage electronic equipment. Always wear an ESD strap when removing or installing a DC input panel.*

Replacing a DC Input Panel

Steps, continued

4. Turn off -48 V DC power to the BCG. Normally this is done at the Power Distribution Panel (PDP).

5. Disconnect the -48 V DC leads to the panel. Be sure that the leads are labeled to facilitate reattachment. Disconnect the ground cable to the panel.

Warning: *Handle -48 V DC cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.*

6. Remove the screws holding the faulty panel in place.

7. Disconnect the cables connected to the rear of the panel. Mark or note these to facilitate reconnection.

8. Open the shipping box, remove the new DC input panel from its anti-static bag, and put it in place at the rear of the BCG shelf as shown in slide 6-13.

Attention: *Handle the panel by the handles on the panel front or the edges of the panel only. Do not touch connectors or components mounted on the face or back of the panel.*

9. Connect the inside cables to the new panel.

10. Hold the panel in place and tighten the screws on the top and the bottom of the panel.

11. Connect the -48 V DC leads from the PDP. Connect the ground cable to the panel

Warning: *Handle -48 V DC cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death*

12. Turn on power to the BCG at the PDP.

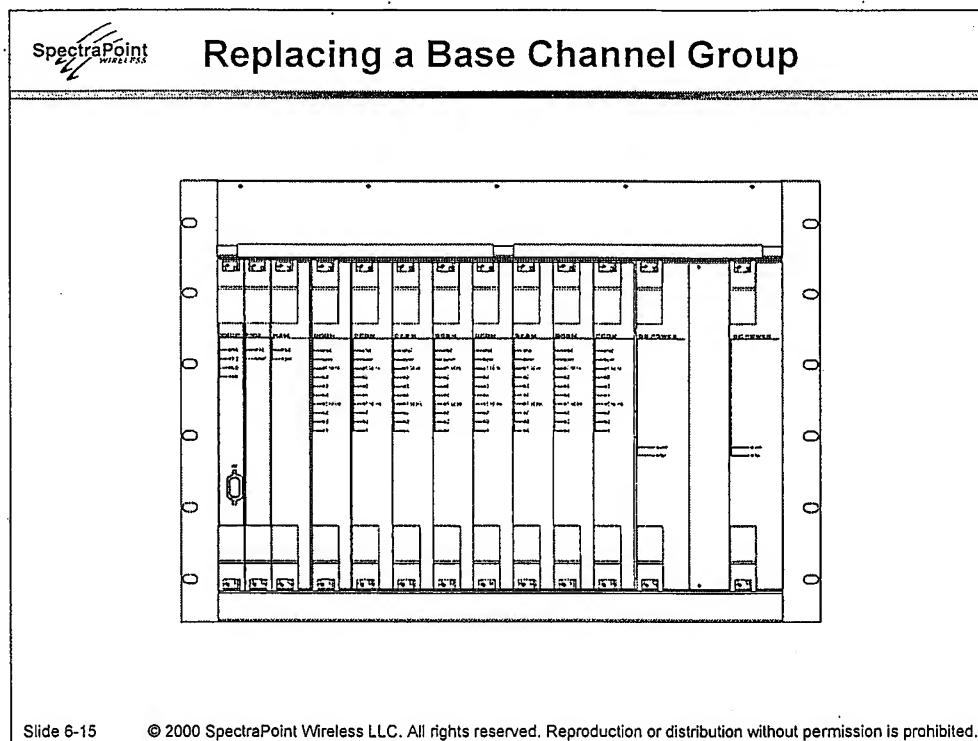
13. Remove the ESD strap.

14. Notify NOC of completion. **Note:** *Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.*

15. Place the old DC input panel in the anti-static bag and shipping box. Mark its status. Follow company procedure for disposition of the card.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for replacing a DC input panel.



Replacing a Base Channel Group (BCG)

Replacing a Base Channel Group (BCG) involves removing the old BCG and installing the replacement unit.

Attention: *Removing and replacing a Base Channel Group interrupts service for all customers served by this BCG. If a redundant BCG is installed, switching to the redundant unit eliminates any service outage. Always notify the Network Operations Center (NOC), notify all affected customers, and accomplish the replacement as quickly as possible following all steps.*

Steps: Removing the old BCG

1. Alert the NOC that maintenance is being performed.
2. Identify the BCG to be replaced per the work order.
3. Move the new BCG (boxed) near its installed location.
4. Turn off the -48 V DC power source serving the BCG.
5. Attach an ESD wrist strap to your wrist and to the ESD bond point on the rack.

Replacing a Base Channel Group

Steps: Removing the old BCG, continued

Attention: *Static electricity can damage electronic equipment. Always wear an ESD strap when removing or installing any BCG circuit card.*

6. Disconnect all cables from the rear of the unit. (To save time during reconnection, be sure that all cables are clearly marked prior to disconnecting any cables.)

Warning: *Handle -48 V DC cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.*

7. Remove the cover from the front of the BCG.
8. Remove the DCDM cards, placing each in an anti-static bag. (The PMD card, DC Input panel, CCCP, FR, HSM, and DC Supply cards are part of the new BCG assembly.)
Attention: *Handle the DCDM cards by the faceplate or by the edges of the card only. Do not touch connectors or components mounted on the face or back of the card.*
9. Remove the screws holding the BCG chassis in the rack.
10. Remove the BCG from the rack.

Steps: Installing the Replacement BCG

1. Open the box, unpack the replacement BCG, and reinserted it back into the space vacated by the old BCG.
2. Using standard rack fasteners, reattach the BCG chassis to the rack.
3. Replace the DCDM Channel Cards, as they were previously installed.

Attention: *Handle the DCDM cards by the faceplate or by the edges of the card only. Do not touch connectors or components mounted on the face or back of the card.*

Replacing a Base Channel Group

Steps: Installing the replacement BCG, continued

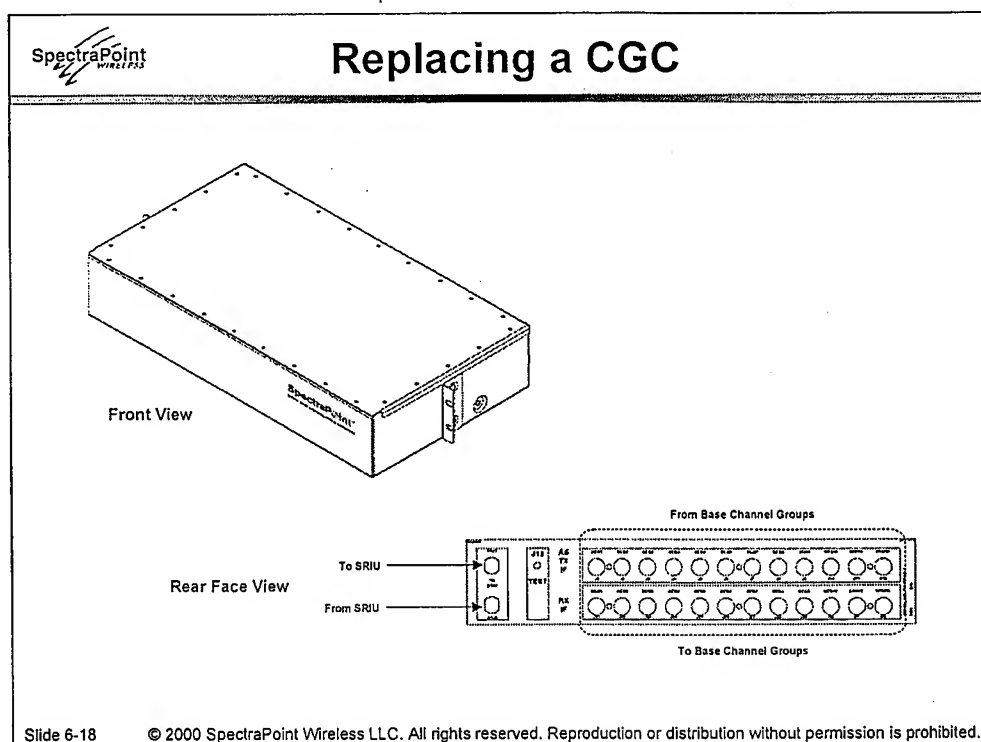
4. Connect all cables to the rear of the unit as marked, including the -48 V DC power cables.

Warning: Handle -48 V DC cables with extreme caution.
Potentially hazardous and deadly voltages are present.
Improper handling may result in fire, electrical shock, or death.

5. Replace the cover on the front of the BCG.
6. Remove the ESD strap.
7. Turn on the -48 V DC power source serving the BCG.
8. Notify NOC of completion. **Note:** Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.
9. Place the old BCG in the anti-static bag and shipping box. Mark its status. Follow company procedure for disposition of the card.

Note: For more information, please refer to the SP2200 equipment manuals.

This completes the procedure for replacing a Base Channel Group.



Replacing a Channel Group Combiner (CGC)

Attention: Removing and replacing a Channel Group Combiner interrupts service to all customers served by this unit (all customers in one Sector). Always notify the Network Operations Center (NOC), notify all affected customers, and accomplish the replacement as quickly as possible following all steps.

Steps

1. Alert the NOC that maintenance is being performed.
2. Identify the CGC to be replaced per the work order.
3. Attach an ESD strap to your wrist and to an ESD bond point on a convenient equipment rack.

Attention: Static electricity can damage electronic equipment. Static electricity can damage electronic equipment. Always wear an ESD strap when removing or installing a CGC.

4. Remove all cables from the CGC, making notes as necessary for reconnection, and be sure that all cables are labeled correctly.

Replacing a Channel Group Combiner (CGC)

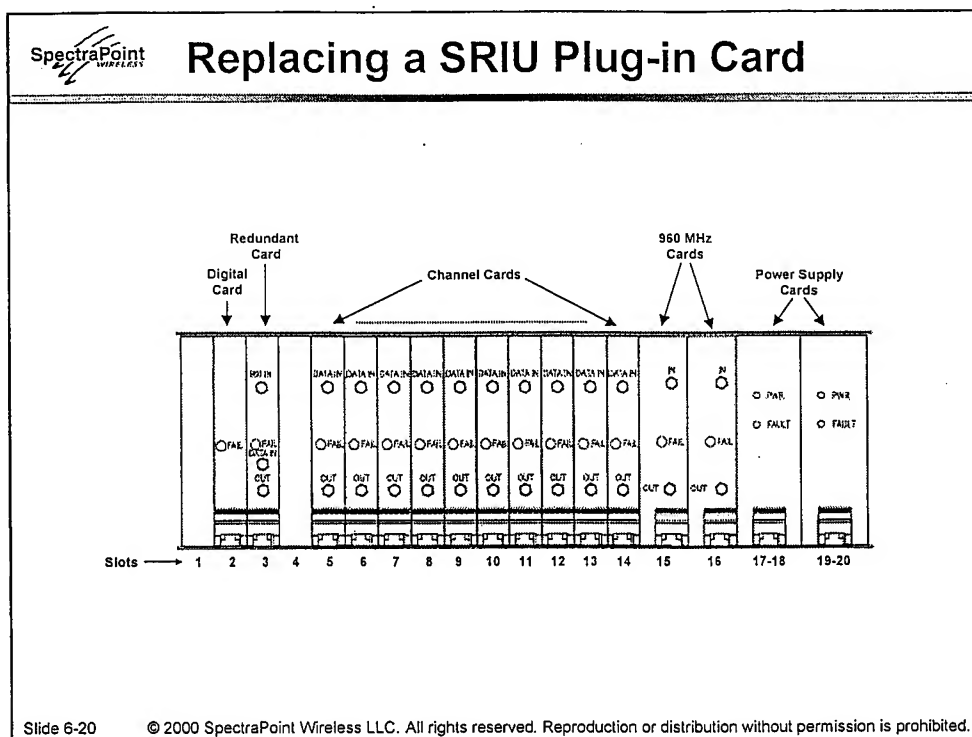
Steps, continued

Attention: *Prior to disconnecting any cables, be sure that all cables are clearly marked to simplify reconnection.*

5. Remove the old CGC.
6. Open the shipping box, unpack the new CGC, remove the unit from its protective wrapping, slide it into the equipment rack and remount it using rack screws.
7. Reconnect all cables to the CGC as labeled.
8. Remove the ESD strap.
9. Notify NOC of completion. **Note:** *Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.*
10. Place the old CGC in the anti-static bag and place in the shipping box. Mark its status. Follow company procedure for disposition of the unit.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for replacing a CGC.



Replacing a SRIU Plug-in Card

The SRIU plug-in cards are located in the card cage inside the SRIU. To access these cards, the front door of the SRIU must be opened.

Attention:

- All SRIU plug-in cards are hot swappable, and will not affect the operation of another plug-in card in the SRIU.
 - The Digital card may be hot swapped, but re-provisioning may be needed.
 - Channel cards may be hot swapped. However, each Channel card slot is assigned a particular frequency which may vary from site to site. Be sure to check card assembly numbers to see if they match before swapping these cards.
 - Replacing a redundant card will not require any provisioning; replacing a non-redundant card will require re-provisioning by the NOC. The Redundant card is assigned particular frequencies which must match the channel frequencies of the Channel cards.

Replacing a SRIU Plug-in Card

Note: Always notify the Network Operations Center (NOC), notify all affected customers, and accomplish any replacement as quickly as possible following all steps.

Steps

1. Alert the NOC that maintenance is being performed.
2. Identify the SRIU to be serviced per the work order.
3. Locate the key to the SRIU and unlock it.

Attach an ESD strap to your wrist and to an ESD bond point on the SRIU.

Attention: Static electricity can damage electronic equipment. Always wear an ESD strap when removing or installing any SRIU Plug-in card.

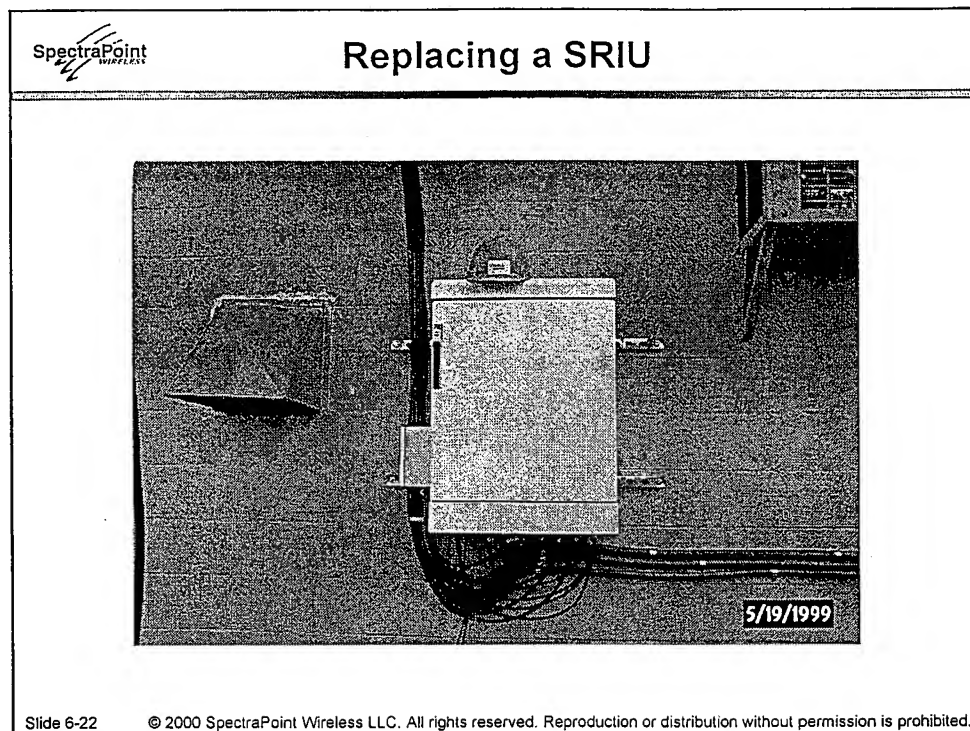
4. Identify the failed card (the LED will be red).
5. Disconnect all cables from the plug-in card.
6. Loosen the card by removing the two screws securing the card, then press and release the card lock mechanism near the bottom of the card. Remove the card.

Attention: Handle the SRIU card by the faceplate or by the edges of the card. Do not touch connectors or components mounted on the face or back of the card.

7. Open the box, remove the new SRIU card from its anti-static bag, and slide it into the correct card slot as shown in slide 6-20.
8. Reverse steps 6 and 5 above to complete the installation, close and lock the door when finished. Return the key.
9. Remove the ESD strap.
10. Notify NOC of completion. **Note:** Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.
11. Place the old SRIU Plug-in card in the anti-static bag and shipping box. Mark its status. Follow company procedure for disposition of the card.

Note: For more information, please refer to the SP2200 equipment manuals.

This completes the procedure for replacing an SRIU Plug-in Card.



Replacing a SRIU

Slide 6-22 shows a SRIU installed on the side of a building structure.

Attention: *Removing and replacing a SRIU interrupts service for all customers served by this unit (all customers in one Sector). Always notify the Network Operations Center (NOC), notify all affected customers, and accomplish the replacement as quickly as possible following all steps.*

Steps

1. Alert the NOC that maintenance is being performed.
2. Identify the SRIU to be replaced per the work order.
3. Move the new SRIU (crated) near the mounting location.
4. Turn off the -48 V DC power supply to the SRIU, and disconnect the power leads to the SRIU. Make sure that each lead is labeled clearly.

Warning: *Handle -48 V DC cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.*

Replacing a SRIU

Steps, continued

5. Disconnect the input cables (TX, RX, and RS-485) from the Base.
6. Disconnect all coax cables (payload), multi-pair RS-485 cables, and LO coax cables to the TXs and RXs. Label all cables before disconnection to facilitate reconnection.
7. Unbolt and remove the old SRIU; transfer any mounting brackets to the new unit.
8. Unpack the new SRIU, and mount in place.
9. Open old SRIU and remove all plug-in cards from old unit. Reinstall cards into new unit in exact order removed from old unit.
10. Reconnect all coax cables (payload), multi-pair RS-485 cables, and LO coax cables to the TXs and RXs.
11. Reconnect the input cables (TX, RX, and RS-485) from the Base.
12. Reconnect the -48 V DC power source to the SRIU.

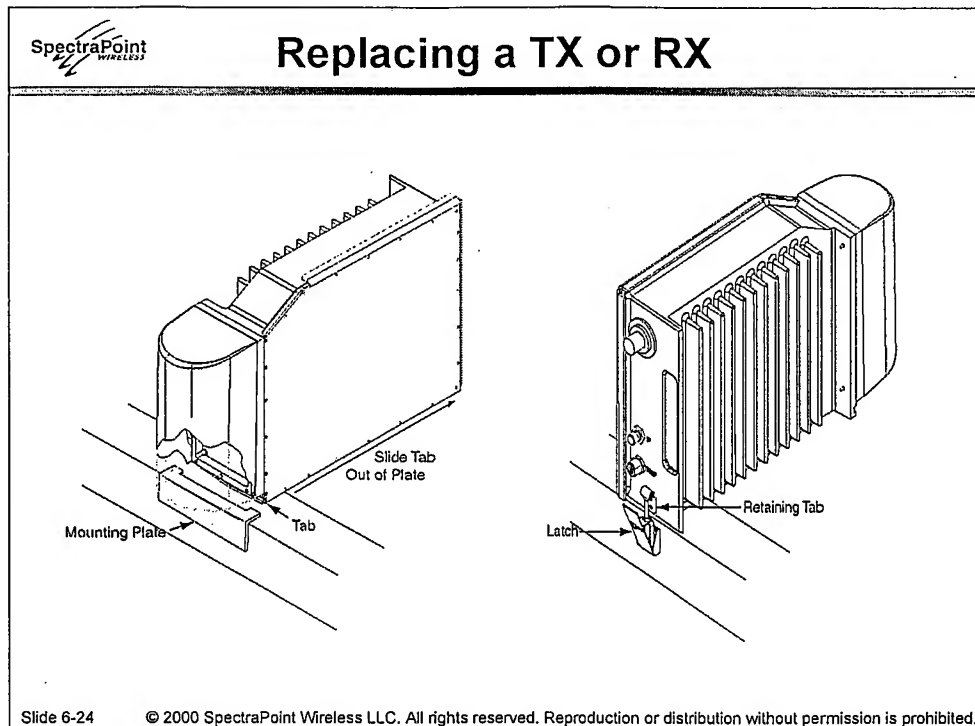
Warning: Handle -48 V DC cables with extreme caution.

Potentially hazardous and deadly voltages are present.

Improper handling may result in fire, electrical shock, or death.

13. Replace any wire ties that were removed, and refresh any cable protection (if needed).
 14. Turn on power to the SRIU.
 15. Notify the NOC of completion. **Note:** *Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.*
 16. Place the old SRIU in the anti-static bag and in the shipping crate. Mark its status. Follow company procedure for disposition of the unit.
- Note:** *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for replacing an SRIU.



Replacing a Transmitter (TX) or Receiver (RX)

The procedure for replacement of a Basic TX/RX or a High Gain TX/RX is the same.

Attention: *Removing and replacing a Transmitter or Receiver interrupts service for all customers served by this unit. If an SRIU is installed, switching to the redundant TX or RX eliminates any service outage. Always notify the Network Operations Center (NOC), notify all affected customers, and accomplish the replacement as quickly as possible following all steps.*

Redundant vs. Non-Redundant

Two methods of replacing a TX/RX are detailed:

- Replacing a Non-Redundant TX/RX
- Replacing a Redundant TX/RX

Replacing a Non-Redundant TX/RX

Steps

1. Alert the NOC that maintenance is being performed.
2. Identify the failed unit that needs to be replaced per the work order.
3. Disconnect the cables connected to the unit from the SRIU; make sure that all cables are labeled clearly.

Warning: *Handle -48 V DC cables with extreme caution.*

Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.

4. Loosen the clamp on the rear of the unit by turning the retaining knob clockwise until the TX/RX can be removed easily.
5. Remove the old TX/RX.
6. Open the box, unpack the new TX/RX, and verify that it is an exact replacement (TX or RX, and polarity).
 - If this unit is correct, position it sitting flat with the radome facing in the direction of the transmission. In this position, all cable connections are in the rear.
 - If it is not correct, follow company procedure to receive the correct unit.

7. Align the tab on the front edge of the unit with the mounting plate on the front edge of the mounting platform.
8. Slide the unit into the Mounting Plate, ensuring that the tab on the front of the TX/RX slides under the mounting plate - the unit is correctly positioned when the tab is fully swapped under the mounting plate.
9. Secure the unit by capturing the retaining pin attached to the rear of the unit in the cup of the self-locking retaining clamp. Tighten the clamp by turning the retaining knob clockwise until it is securely fastened.
10. Reconnect the cables connected to the unit from the SRIU as labeled.

Attention: *Over-tightening the cable connectors will cause cable malfunction, and may require cable replacement.*

Warning: *Handle -48 V DC cables with extreme caution.*

Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.

11. Notify the NOC of completion. **Note:** *Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.*

Replacing a Non-Redundant TX/RX

Steps, continued

12. Place the old TX/RX in the anti-static bag and in the shipping box. Mark its status. Follow company procedure for disposition of the unit.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for replacing a Non-Redundant TX/RX.

Replacing a Redundant TX/RX

Attention: *The following procedure works only:*

- a. *If an SRIU is being used, and*
- b. *A Redundant TX or RX is installed, and*
- c. *Redundancy is configured for the unit.*

Steps: Switching to the Redundant TX/RX

1. Alert the NOC that maintenance is being performed.
2. Identify the failed TX/RX that needs to be replaced per the work order.
3. Disconnect the IF cable connected to the unit from the SRIU. Wait 3 seconds and disconnect the other cables to the SRIU.

Warning: *The RS-485/power cable carries -48 V DC and should be handled with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death*

4. The switch to the redundant TX/RX will be automatic.

Steps: Replacing the faulty TX/RX

1. Loosen the clamp on the rear of the unit by turning the retaining knob clockwise until the TX/RX can be removed easily.
2. Remove the old TX/RX.
3. Open the box, unpack the new TX/RX, and verify that it is an exact replacement (TX or RX, and polarity).
 - If this unit is correct, position it sitting flat with the radome facing in the direction of the transmission. In this position, all cable connections are in the rear.
 - If it is not correct, follow company procedure to receive the correct unit.
4. Align the tab on the front edge of the unit with the mounting plate on the front edge of the mounting platform.
5. Slide the unit into the Mounting Plate, ensuring that the tab on the front of the TX/RX slides under the mounting plate - the unit is correctly positioned when the tab is fully swapped under the mounting plate.
6. Secure the unit by capturing the retaining pin attached to the rear of the unit in the cup of the self-locking retaining clamp. Tighten the clamp by turning the retaining knob clockwise until it is securely fastened.

Replacing a Redundant TX/RX

Steps: Replacing the faulty TX/RX, continued

7. Reconnect the cables connected to the unit from the SRIU as labeled.

Attention: *Over-tightening the cable connectors will cause cable malfunction, and may require cable replacement.*

Warning: *Handle -48 V DC cables with extreme caution.*

Potentially hazardous and deadly voltages are present.

Improper handling may result in fire, electrical shock, or death.

8. Place the old TX/RX in the anti-static bag and in the shipping box. Mark its status. Follow company procedure for disposition of the unit.

Steps: Switching back to the new TX/RX

Note: *This step may be done at the Network Operations Center (NOC).*

1. Go to the Base and connect the CID to the Primary BCG.

2. Log into SpectraPRO:

- From the main window, double click *SRIU*
- Select the *SRIU tab*
- At "*Switch Back from Spare*", change from *RX* to *TX*
- Click *Apply*
- The SRIU will switch back to the new TX
- Close the window
- Logoff

3. Notify the NOC of completion. **Note:** *Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.*

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the procedure for replacing a Redundancy TX/RX.



Base Station Cabling Replacement

- Network access switch to BCG
- BCG to SRIU
 - BCG to Combiner/Splitter
 - Combiner/Splitter to SRIU
 - RS-485 from Base to Node
- SRIU to Transmitters/Receivers

Slide 6-29

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Base Station Cabling Replacement

The replacement of cabling may be divided into these categories:

- Network access switch to BCG
- BCG to SRIU
 - BCG to Channel Group Combiner
 - Channel Group Combiner to SRIU
 - RS-485 from Base to SRIU
- SRIU to Transmitters/Receivers.

Cabling is detailed in the SpectraPoint™ Series 2000 Site Preparation Guide.

Attention: *Removing and replacing cabling interrupts service to all customers served by the affected connection. Always notify the Network Operations Center (NOC), notify all affected customers, and accomplish the replacement as quickly as possible following all steps.*

Base Station Cabling Replacement

Common Steps

1. Identify the failed cable.

Attention: *Replace all cables with the exact type and grade originally used by SpectraPoint Wireless to deploy the Base or Node connections.*

2. Remove the old cable, taking care to keep from disturbing adjacent cables or other connections. Mentally note, or sketch on paper, the routing and connections for this cable.

Warning: *Handle -48 V DC cables with extreme caution. Potentially hazardous and deadly voltages are present. Improper handling may result in fire, electrical shock, or death.*

3. Cut the new cable to length as needed.
4. Strip and crimp the ends of the new cable as needed, using the correct terminals.
5. Connect the new cable, taking care not to damage connection ends or terminals.

Attention: *If replacing both Transmit and Receive cables, be sure to route and connect correct ends of each cable.*

6. Remember to:

- Replace any old rubber boots on the connections if the old ones are suspect.
- Per local practice
 - Replace any wire ties removed to perform maintenance.
 - Refresh/replace any silicone or other type sealant originally used at connection points.

7. Notify the NOC of completion. **Note:** *Once the replacement is completed, any provisioning necessary will be accomplished from the NOC unless otherwise directed.*

8. Follow company policy for disposition of the old cable.

Note: *For more information, please refer to the SP2200 equipment manuals.*

This completes the common steps in replacing Base Station cabling.



Review Questions

- (1) Are BCG cards hot swappable?
- (2) A CCCP card may be installed in slot 12 or 14 in a BCG. True or False?
- (3) The DC Input panel is hot swappable. True or False?
- (4) Where do cables connect to the CGC?
- (5) Any channel card may be used in any slot 5 to 14 in the SRIU. True or False?
- (6) Replacing a Redundant Transmitter is the same procedure as the Non-Redundant unit. True or False?

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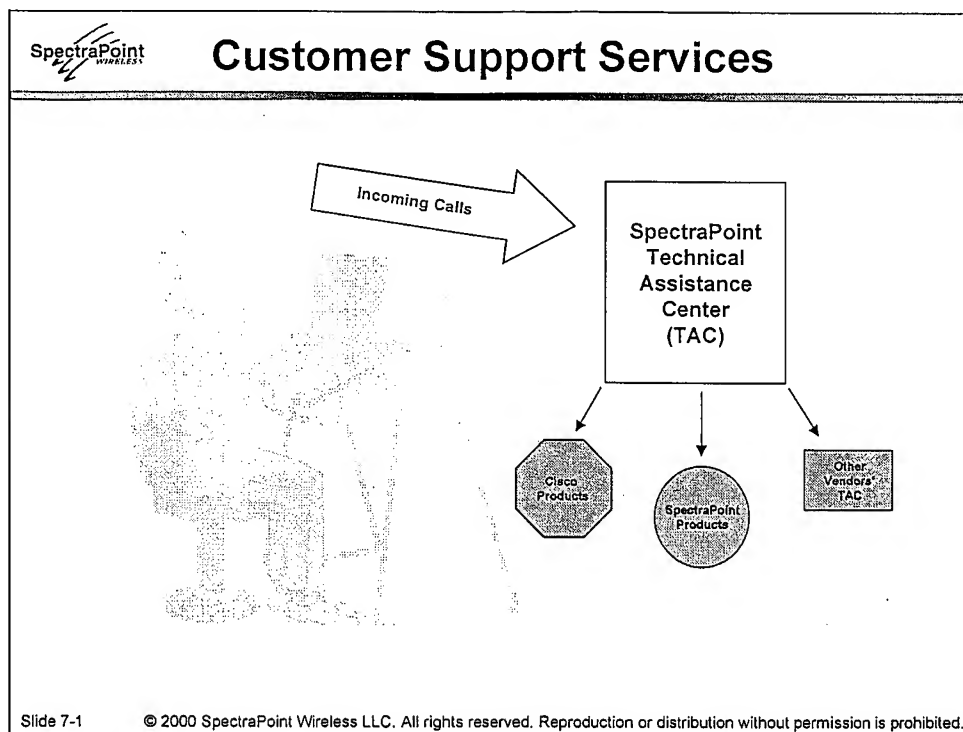
Review Questions

See slide 6-31 for end-of-section review questions.

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Customer Support Services

SpectraPoint Technical Assistance Center (TAC) is discussed on this page and replacement procedures are discussed on page 7-2.

SpectraPoint TAC

To address customer problem resolution, SpectraPoint Wireless established the SpectraPoint Technical Assistance Center (TAC). The TAC is operational 24 hours per day, 7 days per week, 365 days per year and is staffed by factory-trained Technicians. These technicians are divided into groups based on product expertise: SpectraPoint™ RF and LMDS Systems, SpectraPoint™ EMS, and Cisco products. Callers are taken on a first-come, first-served basis. The TAC houses functioning SpectraPoint™ LMDS systems, and virtually any customer problem can be simulated in-house. A technician is assigned to each incoming call, and this individual is responsible for assuring satisfactory resolution of each trouble report.

Services Available:

- Telephone assistance
- Extensive remote diagnostics
- On-site support from local Field Engineers

Replacement Procedures

Note: *Current customer contracts define warranty coverage on any SpectraPoint™ equipment.*

During the Warranty Period**

The suggested procedure for factory replacement of faulty parts is as follows:

- Replace the faulty Base Channel Group (BCG), BCG card (CCCP, FRO, HSM, or Quad DCDM), or Channel Group Combiner (CGC) with a spare from your inventory; or, the TAC can ship advanced replacement equipment to you overnight. Contact the SpectraPoint Repair Center in Dallas at (877) 838-0142, so that the replacement part can be shipped to your central facilities.
- An RMA number will be assigned at that time.
- Return the faulty unit to SpectraPoint Repair Center using United Parcel Service, Federal Express, or registered mail. Be sure to note the RMA number on the outside of the box and on any correspondence inside the shipping box.

**** Refer to your current contract for exact terms of coverage.**

After the Warranty Period**

The suggested procedure for factory replacement of faulty parts is as follows:

- Replace the faulty equipment with a spare from your inventory, or call the TAC for a replacement.
- Follow your company procedure for disposition of the faulty equipment.

**** Refer to your current contract for exact terms of coverage.**

Note: *Prior to sending a product for warranty repair service, the Customer must contact the SpectraPoint Service Center at (877) 838-0142 for detailed instructions and a Return Materials Authorization (RMA) number.*